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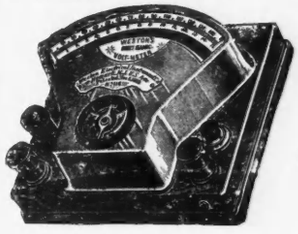

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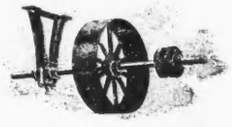

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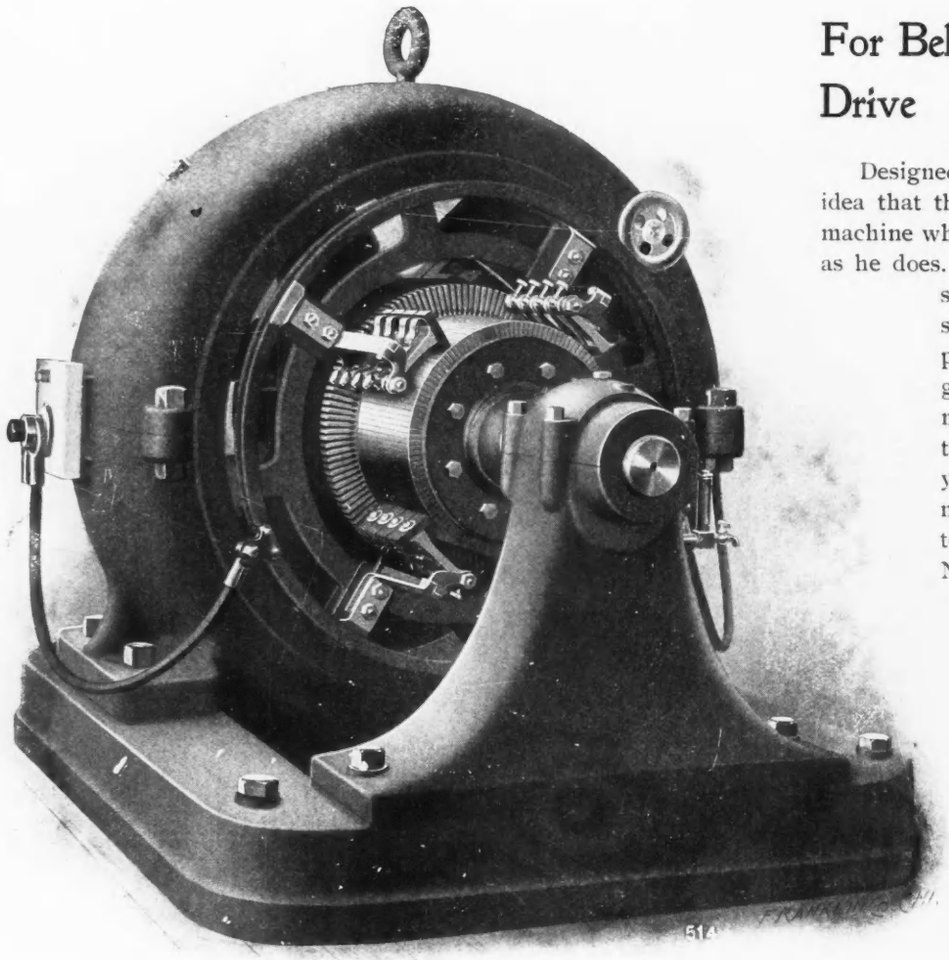

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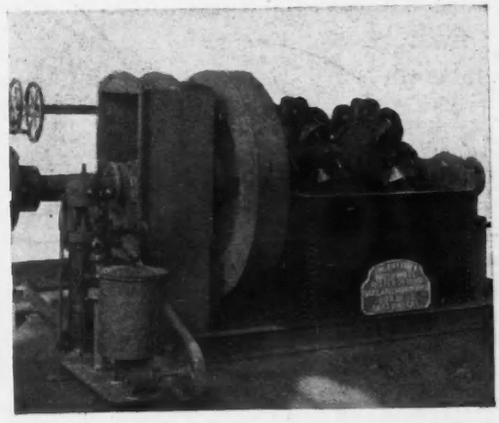

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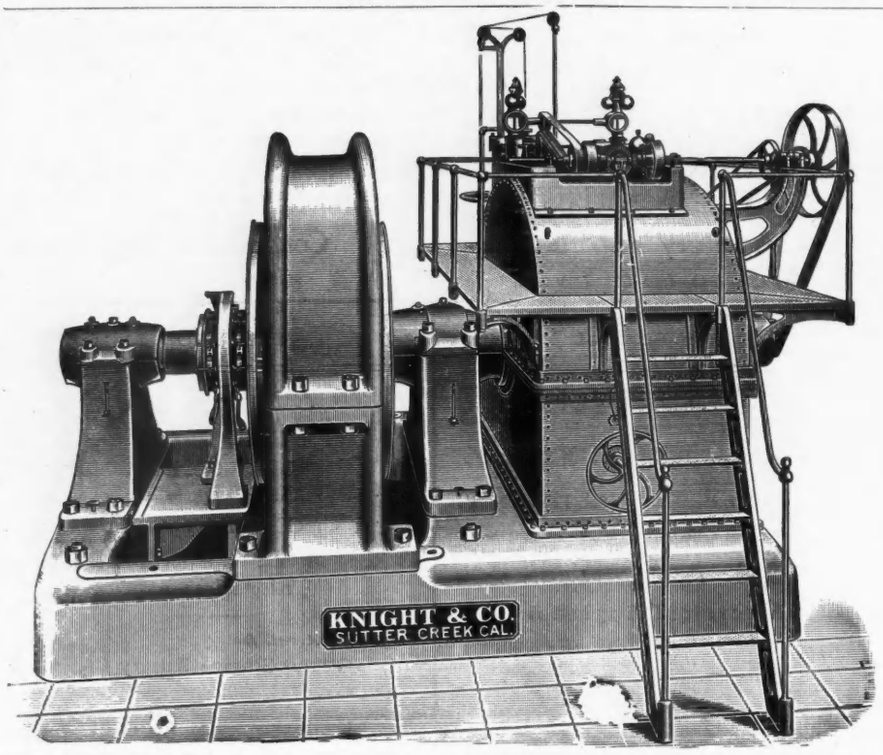

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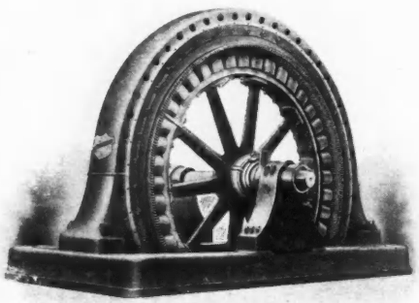

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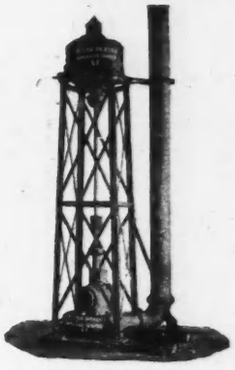

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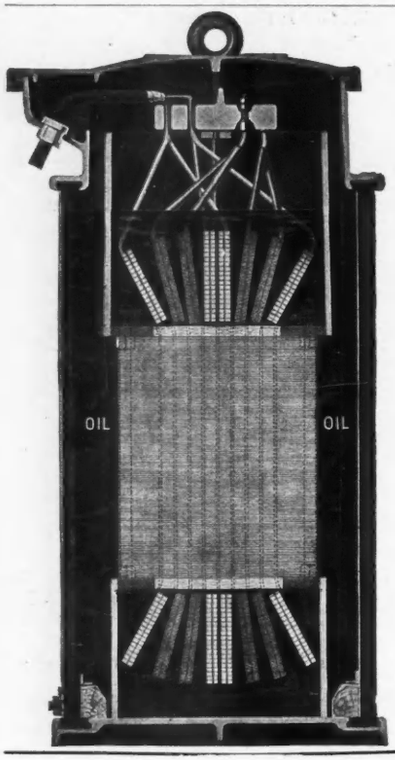

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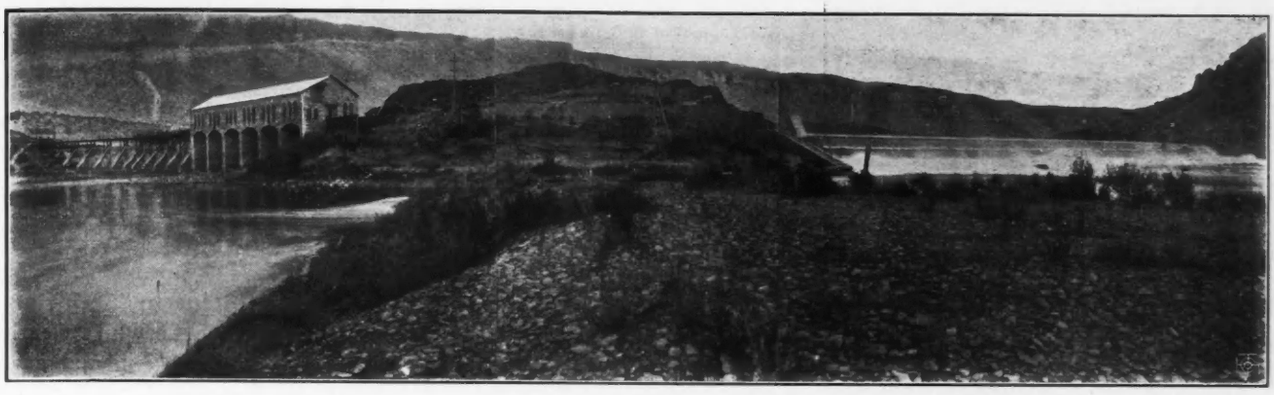


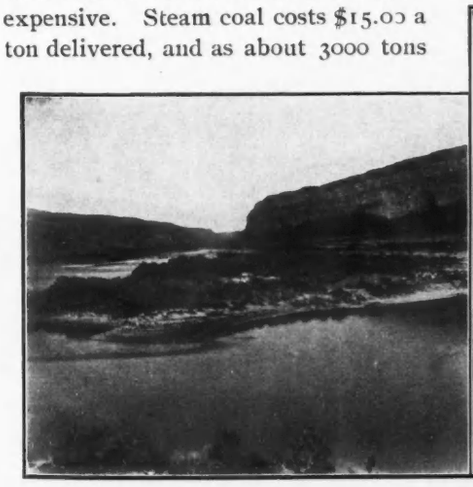
The Swan Falls-Trade Dollar Transmission.

BY E. J. KOPPITZ.

MIDWAY between Boise and Silver City, Idaho, running in a northwesterly direction, Snake River, the main tributary to the Columbia, the headwaters of which have their origin in the famous Yellowstone Park reservation, in Wyoming, winds its way down a steep and narrow canyon, in some places having cut its way through a lava formation a distance of 800 feet below the surrounding country, which in this vicinity is dotted here and there with sage brush, giving one the impression, although on a much smaller scale, of the Grand Canyon of the Colorado.

The adjacent country on both sides of the river being void of timber for fuel purposes, and also the great distance of their location from any railroad, made the operation of the Trade Dollar Mines rather expensive. Steam coal costs $15.00 a ton delivered, and as about 3000 tons was used per year, the fuel bill amounted to about $50,000 annually. It was therefore decided to install an electrical transmission plant on Snake River. After some preliminary surveys on different parts of the river, it was decided to locate the plant at a place called Swan Falls, where the river had a natural fall of about ten feet. This point was further decided upon because of the existance of an island in the center of the stream, which divided the river and could be utilized as part of the dam. The land on the east side of the river was owned by Messrs. White and Cressy, two placer miners who were experimenting with a new gold saving device which Mr. White had brought out from the East. The gold at this particular place being too fine to be saved even by their process, they disposed of their holding to the Trade Dollar Company for a nominal sum.

In April, 1900, work was commenced with a large force of men. Interest in



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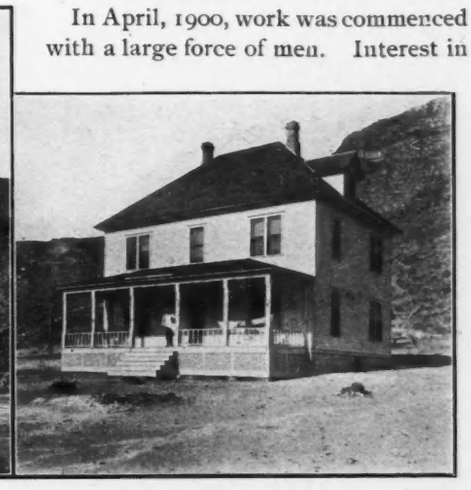
THE POLE LINE.



THE COTTAGE.

the enterprise never flagged, and in eleven months from the time the first pick was stuck into the ground, power was being sent over the line to Silver City.

The first thing to be done was to build a suitable roadway from the top of the canyon to the bottom. About two miles further up the river was a natural sloping valley which came to the water's edge, but it was impracticable to build the road through it, because if it were done, as soon as the dam would be completed the part of the road around the cliffs would be submerged, so the route finally determined upon started at the power house site and by a few turns and some heavy grades wound its way up the steep sides of the canyon. Considerable blasting was necessary to remove some of the rock. In the meantime supplies were brought down through the little valley, better known as "The Red Trail," and so named, perhaps, because of the many Indian massacres that occurred in this valley, which being one of the few places convenient to water, was often used by early settlers as a camping place. While still at work upon the road, work progressed on the coffer-dam that was built from the island to the east bank of the river for the purpose of turning the whole stream through the west passage. A donkey engine and centrifugal pump were used to drain the coffer-dam of seepage water while clearing the bedrock and laying the foundation for the concrete dam and power house.

The power house is a substantial building of concrete with a slate roof. It forms part of the dam, and was built of concrete blocks which were numbered and made to form. The building is forty-four feet by 140 feet in area and runs lengthwise across the stream. Six wheel pits were built, although but four are being used at present. The section of the dam which connects the power house to the island is in reality but a continuation of the main dam, although this section is short, being only some thirty odd feet in length. The main dam is over 300 feet long, is slightly V-shaped, and is built in line with the building for one-half the distance, the remainder heading for a point of rock which extends out from the shore a little distance, thereby shortening and strengthening the dam. The dam across the west passage was the most difficult part of the whole undertaking. As will be seen in the accompanying illustrations a concrete bulkhead was built in two sections, one being next to the island and the other on the west bank. Across these a crib dam was built, its total length being 425 feet. The main channel of the river was close to the bank, which made it any easy matter to put in a coffer-dam, so that the island end of the crib work was comparatively easy to construct. But damming the main channel was a game two could play—nature versus engineering skill. All but about sixty feet of the main channel was closed without much difficulty, but after that the trouble began. Across the open gap the frame-work of a crib was run and huge piles were driven down, only to be washed out. Nothing seemed to be able to withstand the terriffic force of the water. After several vain attempts to use piling, two cribs were built, measuring thirty feet by twelve feet by twelve feet, of twelve inch by twelve inch timber, and placed in a position one on each side of the opening. These cribs were filled with rock and sunk, the space behind them being also filled in until it was solid with the crib-work. When this was accomplished a smaller crib was made and placed in between the two larger ones, when it was also sunk, but it went through the opening with a terrible crash, turning end over end, and breaking up like a house of jack-straws.

After this failure it was next decided to build a larger crib on the east bank, its dimensions to be sixty feet by thirty feet by twenty feet, and of twelve-inch timbers, bolted together with twenty-foot bolts. Captain Clark of Pittsburg was sent out to superintend the placing of this new crib in position across the gap. Before its completion it was floated into deep

water and there finished. The task of taking it up stream was not so difficult as it was tedious. When up stream far enough it was swung across and allowed to float down at the same time, being guided from both sides by heavy ropes. As it neared its destination its velocity increased to such an extent that the strain on the guy ropes caused one of them to break, letting the crib go endwise instead of crosswise. Nevertheless it remained in position after being sunk. Small triangular shaped cribs were next made and placed around the larger one The whole thing was then filled in with rock and gravel, and today it is claimed that there is not a more substantial crib dam in the entire western country.

The contracts for the hydraulic machinery were given to the S. Morgan Smith Company, of York, Pa., which furnished four seventy-two-inch vertical McCormick turbines, to operate under a head of seventeen and one-half feet, with a speed of seventy-eight revolutions per minute. The arrangement of the wheels, line shafting, pulleys and generators can best be explained by reference to the illustrations on this page. There are six jaw clutches on the main shaft, dividing it into seven sections, four of which are taken up by wheels and three by driving pulleys, thereby enabling any combination to be made. The governor here used is a Type B Lombard. A seven and one-half horsepower Type C induction motor drives the governor pump, while a three and one-half horsepower motor drives the governor end of it. The gearing is so arranged that either one or all the wheels can be connected. The screen in front of the wheels consists of flat iron bars, three-eighths of an inch by two inches, set one inch apart, in a vertical position.

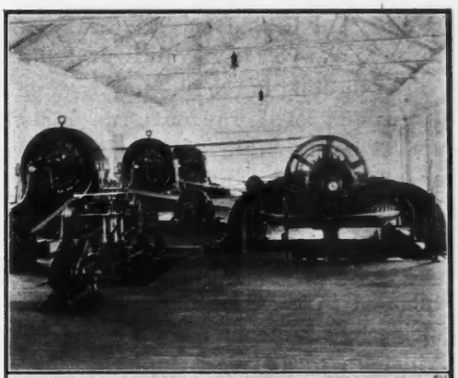
The generators, as well as the rest of the electrical equipment, was furnished by the Westinghouse Electric and Manufacturing Company. The generators are three in number, each being of the 300-kilowatt, 500-volt, sixty-cycle, two-phase, three-bearing type, running at a speed of 514 revolutions per minute. The pulleys on the machines are wide enough to accommodate a forty-four inch belt. Two fifteen-kilowatt, 125-volt, multipolar machines furnish the exciting current. They are belted from the main shaft next to Nos. 1 and 3 generators. No. 2 generator may be run in parallel with either No. 1 or No. 3.

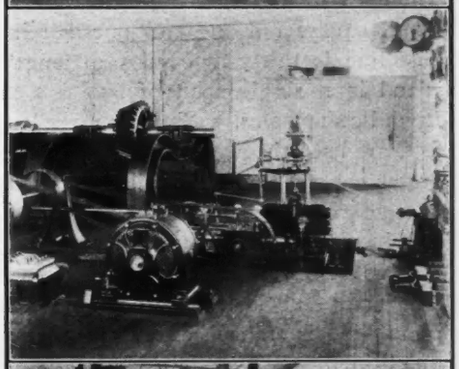
The switchboard is of white marble and contains seven panels, made up as follows: Panel No. 1 is the exciter panel, and contains two voltmeters, two ammeters, two rheostats, and two triple pole single throw switches besides the voltmeter plugs. Nos. 2, 3 and 4 are machine panels, and each contain two alternating current ammeters, one direct current ammeter, field rheostat, and a four pole single throw switch, besides voltmeter plug, ground detector switch and lamp, and synchronizing device. Panel No. 5 is the load panel, and contains two alternating current ammeters, a kilowatt meter, and a recording wattmeter. Panels 6 and 7 are feeders, and each contain two alternating current ammeters and two double pole single throw switches. Two voltmeters on a swing-arm bracket are on the left hand side of the board.

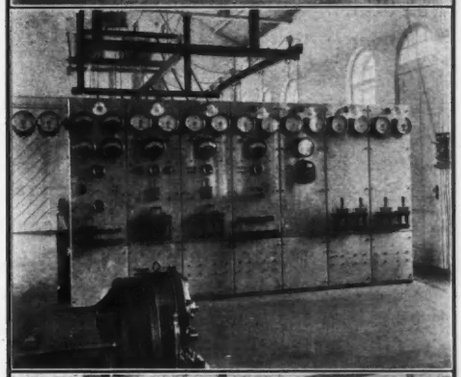
Current is conducted through lead covered cables from each machine, which pass through the concrete floor through glazed clay bushings. Insulator racks under the floor carry the cables to the switchboard. From the feeder panels the cables pass through the floor and come up behind their respective transformers.

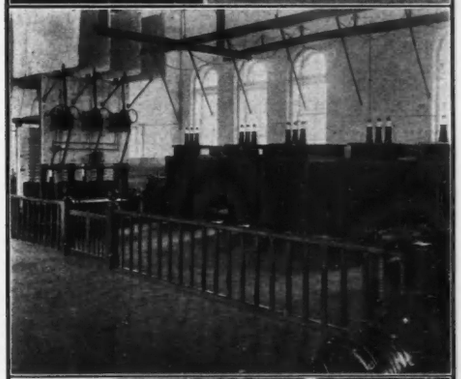
The raising transformers are five in number, one being held in reserve. They are of 160 kilowatts each, and are of the air-cooled and oil-insulated type, stepping the voltage up from 500 to 22,000 volts. They are connected two-phase on the low tension side and three-phase on the high tension.

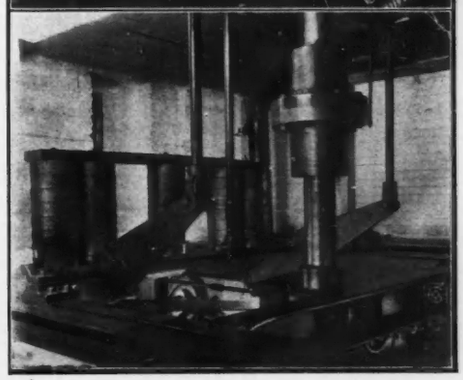
The high tension switches used are of the broomstick type, and connect each high tension lead to the high tension busbars. They answer every purpose for which they are intended. A time limit circuit breaker











is used, and behind this are three static interrupters and three 22,000-volt low equivalent lightning arresters.

The lighting of the building is done by three Adams-Bagnall enclosed arc lamps, run from the 125-volt exciters. The incandescent lamps, supplied from a transformer, are placed along every beam, so that the chances of being left in the darkness are reduced to a minimum.

The insulation through which the line passes as it leaves the building is a hard rubber tube, four feet long, enclosed in a seasoned piece of timber measuring six inches by six inches, and three and one-half feet in length, which in turn passes through a piece of marble thirty inches square and one and one-half inches thick. The pole line is thirty-two miles in length and leaves the island in a single span of 600 feet to the west bank. Round cedar poles, with an average length of thirty-five feet, are used throughout, and the line is of No. 4 hard drawn copper, the wires being placed four feet four inches apart, forming an equilateral triangle. Forty thousand-volt insulators, made by the Hemingray Glass Company, of Kentucky, are used, and give splendid satisfaction. The main line is transposed but twice, while the telephone line is transposed every other pole. It is a very quiet line.

Power is distributed to various places on the company's property, where circuit breakers, static interrupters and lightning arresters are used at each step-down station. Lightning is a thing to be guarded against, as Silver City is 8000 feet above sea level. The motors used range in size from two to 100 horsepower, and in entirely supplanting steam they are performing each and every duty requiring power in mining service.

A substantial hard finished two-story house, with all the modern conveniences, was erected by the company at the falls for the use of the operators. A number of trees and a garden were set out, which turned a barren waste into a very comfortable abode, about which the barns, blacksmith shop and oil houses gives the place the air of quite an enterprising community. In fact, the extreme consideration which the company gives to insure the comfort and welfare of its employees is conceded by it to constitute one of its wisest investments.

Of this company the Hon. James Hutchison is general manager. Mr. Willard White was superintendent during construction and Thomas F. Johnson was consulting engineer. To A. J. Wiley, the mechanical and hydraulic engineer, is due the credit of the supervision of the installation of the undertaking, while Mr. James Johnson, of the Mountain Electric Company, of Denver, Colo., was the electrical engineer for the Westinghouse company.

And this utilization of a few of the innumerable waterfalls to be found in the United States for the transmission of electricity to run the machinery of all kinds of enterprises, is only the beginning of a system that is destined in the not far distant future to revolutionize the motive power of the world, for this is a system whose marvelous potency will soon be felt wherever the sun light of civilization extends.

OIL BURNING.

BY FRANK H. BATES.

PART I.

THE purpose of this article is to briefly review the F 'low system of oil burning, which is generally conceded produce maximum results with oil fuel. The subject ma. oroperly be treated under three heads, viz.:

I. Methods and apparatus used for the preparation . .d delivery of oil to the burners.

II. Proper atomization of the oil and types of burners employed.

III. Furnace construction and its bearing on fuel economy.

The present paper will deal with the first topic only.

The first point presenting itself will naturally be storage capacity, which is governed by the requirements of the plant with reference to the quantity of oil, necessity for uninterrupted

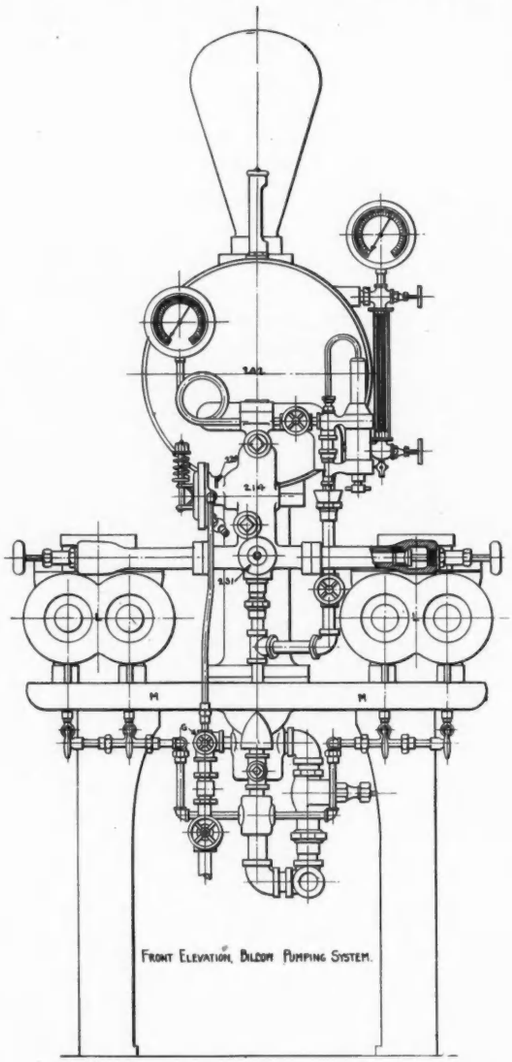


FIGURE 1.

service and certainty of delivery. Aside from this, proper consideration must be given to suiting tankage to the requirements of the fire underwriters, and to making provision for heating the oil when it is low in gravity, or to be used in a cool climate, in order to insure its steady flow to the pumps.

The purpose of the pumping system is to draw the oil from the storage tanks, free it from all mechanical impurities, heat it to a temperature requisite for its proper atomization, and to force it under uniform pressure to the burners, while proportioning the oil feed automatically to the load, so as to maintain a constant

pressure of steam at the boiler. The system should also be at all times under control of the operator, and be suited to handling the several grades of fuel oil with equal economy.

The Billow system consists of a battery of two (2) Snow duplex steam pumps *(L)*, specially brass fitted for oil, and a cast-iron receiver (202), tested to 200 pounds hydrostatic pressure, mounted on a cast iron drip pan *(M)* and base frame upon which the mechanism is securely fastened. A partition divides the receiver (202) into two compartments or chambers. Projecting into the rear chamber and screwed to the partition are tubes with fine gauze heads, accessible through the rear head *(N)* of the receiver. These heads act as a filter or straining medium, and the compartment is provided with a blow-off pipe and valve *(J)* for removing

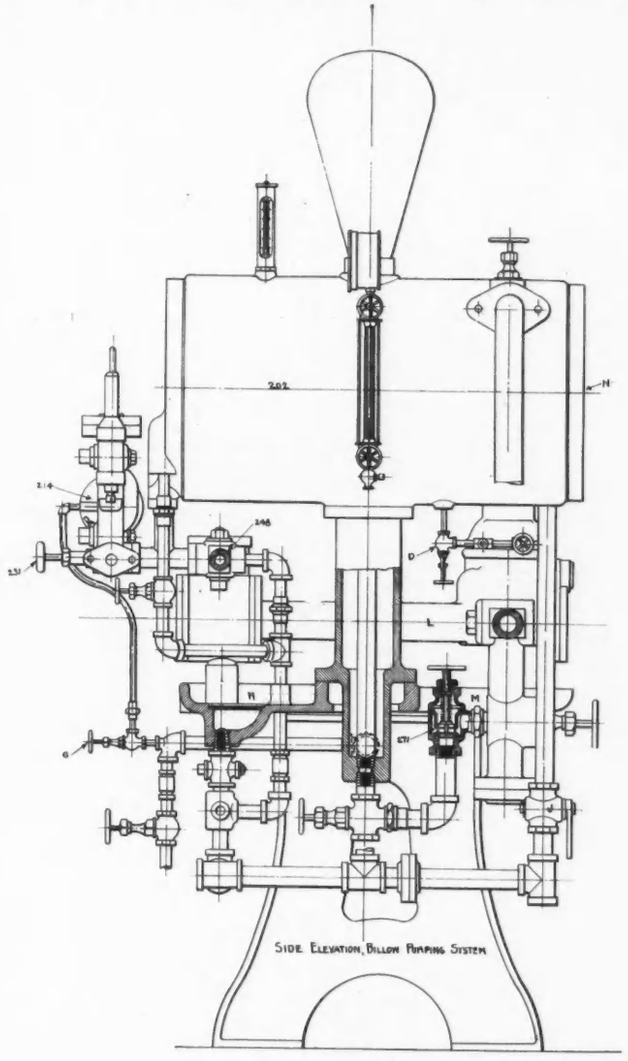


FIGURE 2.

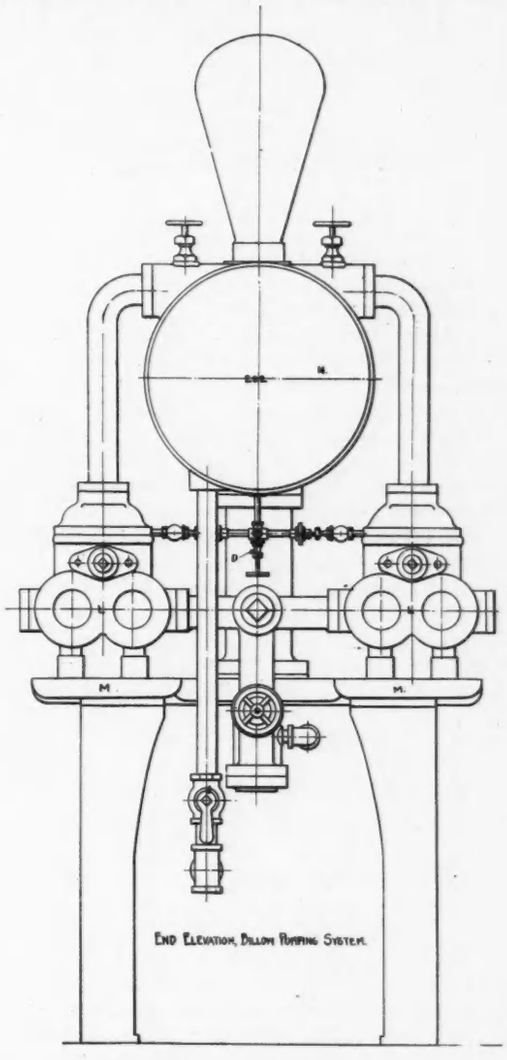


FIGURE 3.

any sediment or extraneous matter deposited therein. The forward or heating chamber of the receiver (202) usually carries two-thirds full of water, and contains a coil of pipe through which live steam or exhaust steam from the operating pump flows. The coil has suitable controlling valves (231) for live and (248) for exhaust steam, permitting the use of steam from either of these sources, or both at the same time.

The heat employed should be sufficient to raise the temperature to a point just below that required for vaporization, this point varying with kind of oil used and pressure carried. To determine this point raise the heat until the oil issues from the burner in puffs, the puffs being caused by gas and liquid fuel coming successively from the tip. Now decrease the heat by throttling the steam to heater until the puffing ceases, which is indicative of the fuel being in a liquid state, yet at its maximum temperature for this state, a state in which the cohesive attraction of the molecules of oil for each other is least, and when, in consequence, the atomization may be most completely and economically effected. This is a point that should be very carefully noted, it being a very considerable factor in the efficient use of oil.

With the duplex system but one pump is used at a time, the other being held in reserve to guard against probable contingencies or possible accident to the working parts. In action the course of the oil is from the storage tanks to the pump, then from force chamber into rear compartment of the receiver, through strainers into heating chamber, where in contact with the hot water it deposits any extraneous matter not rejected at the strainers, which matter gravitates through the body of water and is blown off from time to time. The mechanical separation of the water and oil permits of the use of oil containing any percentage of water, an element giving rise to very uncertain operation with the ordinary system. The oil absorbs the heat from the hot water and from the steam coil, and passes through an inner tube to the pipe line leading to the burners.

In general the oil is maintained at a constant pressure in the heating chamber of the receiver by means of the governing devices (214), the feed at the burners being adjusted to suit the conditions of load. When desirable, however, the governor (214) may be operated automatically so as to maintain a constant boiler pressure with any given feed at the burners. This is accomplished by simply closing valve *(G)* and opening cock (220). A relief

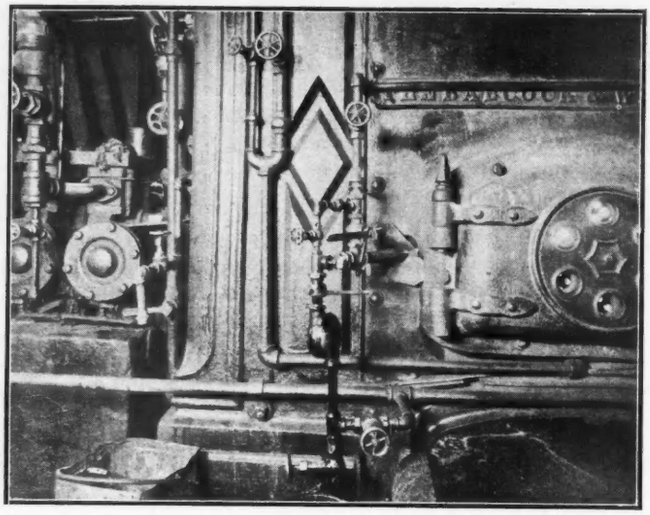


FIGURE 4.

valve (271), adjustable as to pressure, is also provided and placed between the suction and the delivery side of pump, permitting, in case of accident to the governor or excessive flow of oil, of the passage of the resulting excess of oil back to suction.

Provided with this system are steam, oil, pressure and automatic closed sight gages, also thermometer.

Summing up the pumping system offers an extremely compact apparatus which is capable of automatically delivering clean oil under uniform pressure and temperature to the burners. All joints being machine faced, metal packed, and the whole assembled in the machine shop, rather than in the field, insures a tight, odorless and efficient system as compared with installations consisting of an assemblage of innumerable pipes and joints.

Figures 4 and 5 are illustrative of the latter, and, as readily seen, introduce a complexity of piping entirely avoided by the Billow system.

The claim that the system is a closed one is strongly evidenced when one notices that even the reliefs for collections of air in pockets which may occur in starting are all piped from a common tee lead from oil pump chambers and reciver by valve *(D)* directly to the storage tank, and that all blow-offs and drip-bleeders are closed to common drainage lines.

These pumping systems are manufactured in various sizes of capacities ranging from 10 to 18,000 horsepower, and in both single and duplex type.

(To be continued.)

TO PREVENT ASPHYXIATION.

INSTANCES wherein asphyxiation occurs to workers in atmospheres endangering life from gas leaks and impure air are happily rare, but nevertheless accidental deaths from such causes do sometimes occur, and any effort being made toward the elimination of the danger is entitled to serious consideration. A recent contribution to a London contemporary* describes apparatus which seems to embody both novelty and merit.

It is stated, in describing the apparatus, that the man whose task it is to enter the dangerous place fits on a light helmet which is connected up to a reservoir containing air under a slight pressure, the pressure being obtained by a double-acting pump, which can be operated by a boy. A steady gage is maintained on the air vessel, just sufficient to send the air through the length of hose employed. The helmet has a front of toughened glass, protected by brass bars, and the back part and hood are of water and air-proofed cloth. The fitting connecting the tube to the helmet is of aluminum—thus lightness is kept in view throughout. The base of the helmet has a certain spring in it, which causes it to fit tightly round the wearer's neck, so that nothing but the air coming from the pressure vessel can reach the interior of the helmet. The air exhaled finds an outlet through a gauze-covered opening in the upper front of the helmet. For use in places where there may be risk of fire, helmets of the same kind can be made of asbestos or aluminum.

Another apparatus which is being introduced is more especially intended for use in coal mines and other places far removed from pure air. The rescuer carries a breathing bag strapped on his chest and an oxygen cylinder strapped on his back. He admits oxygen into the breathing bag as required, and breathes from and into the bag, which contains loofah pads saturated with a solution of caustic soda, which absorbs the carbonic acid from the air exhaled into the bag, thus permitting a small quantity of oxygen to serve for a considerable time. With this apparatus, which is extensively used in continental coal mines, it has been found that a man can readily work in an irrespirable atmosphere for at least two hours.

A COMBINATION FOR TRACTION PURPOSES.

FROM America comes the report of a bold departure, in which alternate currents of the single-phase type, which have not been used as yet for traction purposes, are employed, in connection with compressed air, for traction work. The apparatus is only at present used for railway work, and it is being installed in a Western State—it is in the West that American engineers try all their new experiments—but it will be of interest to colliery managers because something of the kind, some combination of electricity and compressed air, and particularly some arrangement of alternate currents and compressed air will more than probably be used in mining work. A railway line sixty miles in length is being installed in the State of Michigan, on which the inventor calls the electro-pneumatic system, twenty miles being ready for opening.

The arrangement is of startling novelty, says *The Colliery Manager*, of London, so startling, in fact, as to have formed the feature in the recent convention of the American Institute of Electrical Engineers. What is termed a synchronous alternate current motor is employed as the main driving motor of the car, but connected with the motor are two compressed air engines, ordinary reciprocating engines, using compressed air for their motive agent. The alternate current motor is constructed so that its field magnets and its armature both revolve in either direction, and each is connected to one of the compressed air motors. The alternate current motor always runs at one speed with reference to its field magnets. That is to say, when the field magnets of an alternate current motor are stationary, or when the armature of an alternate current synchronous motor is stationary, and the field magnets revolve, either around it or inside it, the speed is always constant, no matter what the load may be, until the motor is overpowered, and then, as soon as it drops out of synchronism, loses its speed, owing to the excessive load, it also loses its current and comes to rest. This has been one of the difficulties in the use of the single-phase alternate current synchronous motor, which has obliged it to be used only for work, such as driving a factory, where the speed is always constant. These features have put it out of the running for tramcar or railway or similar work.

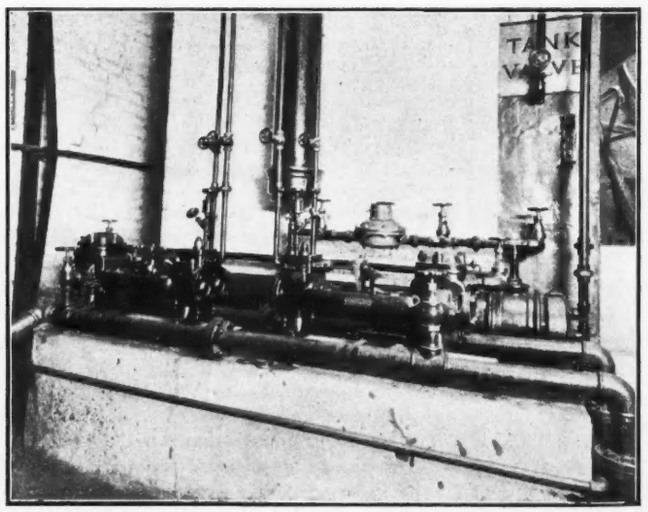


FIGURE 5.

The Sixth Annual Transmission Convention.

Official Report of the Discussions Held Upon the Papers Read Before the Recent Meeting of the Pacific Coast Electric Transmission Association.

IT has often been said that the meat of any paper read before a technical or engineering society is never served in its most piquant flavor until seasoned with its discussion. If this simile be true—and who shall gainsay it—then unusual interest will be attached to the following verbatim report of the proceedings of the Sixth Annual Convention of the Pacific Coast Electric Transmission Association, held in the Maple Room of the Palace Hotel, San Francisco, on the 17th and 18th of June last. The papers presented have all appeared in the columns of THE JOURNAL, each as specifically indicated by foot-notes.—THE EDITOR.

THE PRESIDENT. Gentlemen, please come to order. We will dispense with the reading of the minutes, and as we have a quorum present, I will declare the body duly organized. The first business to come before us will be an address by the president on various themes, but more especially on the "Equation of Success" in the commercial operation of electric power transmissions. The success of our meeting will depend largely upon the discussion that will follow the reading of papers. We are extremely anxious that we shall have the very fullest discussion of all the papers that are to come before us today. My own is not theoretical; it is practical. My hope is that there will be an extensive discussion of a number of practical matters that I suggest. Of course, all I can do on these lines is to make suggestions, and my whole purpose this morning is to begin a discussion that will be of value and call forth thought on these various practical themes from a great many of those who are present.

[Reads paper.]*

THE PRESIDENT. Now, gentlemen, we will be very glad to have you discuss anything suggested in the paper, or anything allied to these themes, at the present time. We have about an hour—plenty of time for everyone to relieve his mind on some of these subjects. At least some of these themes seem to me to be particularly pertinent to the occasion and to call forth discussion which would be valuable to us. The problem of depreciation; the problem of permissible distances; the question of strikes as bearing upon our policy: the agitation in favor of expropriation of water rights and all natural resources; the question of safety devices; the question of the wisdom of insuring in accident insurance companies, and many others. I take the liberty to call on Dr. Addison. He has given great attention to the practical commercial side. He can give us some criticism.

DR. THOMAS ADDISON. Mr. President, and gentlemen of the Transmission Association: I am ashamed to say that this is the first year that I have had the pleasure of attending one of these meetings. I perhaps ought to give some good reason for it; but the principal one is that I have been quite busy, and I have always had men with me whom I thought could get more out of it than I could, and I have tried to give way to them. I am very glad, indeed, to have this pleasure and to have listened to the paper of your president. I have been in the electrical business too long to attempt to discuss a paper or to attempt to teach a man the tricks of his own trade. During my early life I was a farmer boy, and I have plowed fields backwards and forwards and covered every foot of them, and I felt after I had finished that I knew those fields thoroughly. I feel that Dr. Van Norden has plowed this field from the promotor to the borrower, and that he knows it from beginning to end, and that he has covered it thoroughly. It would be difficult indeed for me to add anything to what he has said from the commercial side, and yet it is perhaps well to emphasize that fact and to also emphasize the fact that the commercial side is oftentimes independent of the distance of transmission. I have heard a common reference to two plants in this State, one transmitting electricity something over eighty miles and the other I think under twenty-five, in which the total cost per kilowatt delivered in the same town is less with the eighty-mile transmission than with the twenty-five mile. Now that often is the case in all sorts of transmissions, so that I think your president would bear me out when I say that the gist of his paper that he wants to put before us is that we should study carefully each individual case of transmission by itself; that no rule that can be laid down as to the distance to be transmitted or the amount of power to be transmitted will cover all cases. The man who puts his money in should certainly study each individual case, from the appropriation of water to the time when the power is delivered to the customer and the money is collected for it in the town or wherever it may be sold. I am very glad indeed that your president has touched on some of these outside matters, like this action of the water conservation society (I have forgotten its name), and also upon some of these other matters which lie outside, perhaps, of the technical part of the work. They are certainly things that must be taken up by the men who are interested in electrical power transmission, and I am glad that we have so worthy a representative at the seat of power in Sacramento to look out for some of these various things that I know his hand has been in. I sincerely hope that he may continue there to look out for some of our interests. I feel also that we all stand together in this association on all these problems. Each one of us may have some particular ideas as to which system is a little better, perhaps, than some others, but I am glad to know that this society has seemed to drop that, and that the question of transmission of power from the standpoint as presented by our president is the principal thing. I will not take up your time by discussing any of these problems, because I feel that there are those here who have given the matter more attention than I have, and who are better able to touch upon them.

MR. C. O. POOLE. Mr. President: I think our president has set a rather hard problem for us to solve today, if he wishes us to attempt to form an equation as to the distance that electric power may be transmitted economically and efficiently. As Dr. Addison has stated, it would seem to indicate each as an individual case. Every particular case is one of its own. Promotions and schemes that were started two or three years ago would hardly be profitable or successful if started on a basis of prices of fuel, etc., to-day. While transmission losses, so far as electric lines are concerned, may be reduced to a reasonable extent, after you get your current to your customer you have still the problem to face of how much they can afford to pay for it as compared with generating it on the ground, and that is principally a question of fuel. In the last two years California has changed its aspect entirely by the introduction of fuel oil. The question of safety of our lines, the uninterruptedness of our system—of our delivery—is a very important thing. That can be overcome by duplication of pole lines, reserve storage batteries and things of that kind at the end of the line; but after all that has been accomplished, it resolves itself down to the first principle of what you can deliver your current for, taking into account the property depreciation, operating expenses, etc. Our president has called attention to one thing which is in my

*THE JOURNAL, Volume XII, page 123, July, 1902.

estimation, of especial interest, and that is the promoter of electric power transmission schemes. They invariably dodge the depreciation item, which to my mind is a very serious thing, and many of them depend upon unforseen good prices or good luck or something of that kind to take care of the depreciation at the proper time. Some people, I believe, undertake to write off the depreciation by carrying it along in repairs and running expenses, and taking their chances in that way. My opinion is that a great many of these schemes that are floated would not be considered if the proper factor of depreciation were taken into account at the beginning. I think that is something that too much stress cannot be put upon, because it misleads capital in a great many cases. While change of conditions has a great influence, still a proper starting of the scheme has everything to do with it. The question of safety of our lines as regards injuries to life and property is another very important thing. In my opinion, the first construction of a line is the best preventive. In other words, mechanical construction sufficient to stand all mechanical strain that is likely to be thrown upon the line. Place the high tension wires above everything else—trees and all other wires. I think that would tend very largely to overcome any troubles that heretofore have been noticed. The principle trouble in regard to danger lies in the fact that small wires—telephone wires, telegraph wires and things of that kind—are strung over the high tension wires. They naturally deteriorate very much quicker than the transmission power lines. They are weaker in construction, and in my mind should not be permitted above high voltage lines. I think the elimination of some of these small lines will do away with a great deal of the danger we have to fear.

THE PRESIDENT. Allow me to correct what may be a false impression in regard to my position as to permissible distances. I am not looking upon the permissible distances as a constant. It is the result of an equation, and the permissible distance will depend upon those factors, some large and some small. Permissible distance for one scheme, commencing in one country and ending in another city, may be very different from what it would be in another part of the same State. So that permissible distance is not at all a constant. That is the point I was trying to get at. It is the result of an equation that I want to cover that will help a man to decide what is the permissible distance, given all these factors. I wish Mr. Lighthipe would give us his idea as the result of his experience and observation as to the average depreciation of a long transmission plant. What percentage is it?

MR. LIGHTHIPE. Mr. President, it is a pretty hard thing to figure the depreciation on any piece of electrical apparatus. You take any piece of apparatus that is ten years old, and although it may be in good working order, as a piece of electrical apparatus, it is absolutely obsolete. We find that out in our fire adjustments. You take any piece of our modern apparatus as it stands today, and the chances are that it will be out of use ten years from today, no matter what it is. That has been the history ever since the beginning of our industry.

THE PRESIDENT. Would you place the depreciation at 10 per cent., at least?

MR. LIGHTHIPE. I think the depreciation is absolutely unknown today.

THE PRESIDENT. From your remarks, I should judge that you thought it was not less than 10 per cent.

MR. LIGHTHIPE. I should say it would be absolutely obsolete in ten years. Looking back on the history of all our developments —you take the arc machine, going through the various stages and the improvements. Today a direct current arc is obsolete; und yet Sacramento, Fresno and Los Angeles all installed arc machines within five or six years; they bought the very latest machines, and today these arc machines are absolutely obsolete, in my estimation. We no longer use a revolving medium to transform the alternating current to the direct current for arc illumination. We have dropped it and use a current transformer with an automatic device in which we can use the alternating current. It was only about five or six years ago, I think, that Mr. Gilbert, at that time in Sacramento, was bemoaning the fact that we could not use arc lamps to fight the Welsbachs with. He said: "If we could only use the old Edison direct current we could get an enclosed arc lamp of small ampere capacity, and we could fight the Welsbach." Today we have that lamp just as good as the direct current lamp ever was. It is becoming more and more popular, and it is in use almost everywhere. The same idea has gone through the various types of the three-phase and the two-phase machine. We have started with the revolving armatnre type with its low potential winding. Today, I think, all the companies are making the revolving field type, with the wires that are liable to burn out, the wires that need superior insulation, standing still in the frame of the machine. That development has all been made within the last three or four years. I think southern California had the first machine that had the revolving field type on the coast, and the Edison company of southern California is a new company—it is not more than four or five years old. The same way with transformers. We are making larger and larger transformers. We are increasing the potential and capacities. The fact is, I think the limit of voltage of a commercial transformer is today somewhere in the neighborhood of 100,000. I don't think our company would hesitate very long to build a 100,000-volt transformer if the order was there. I don't think we have reached that state yet, but I don't think we would hesitate to design one. Consequently we are running into a type of transformer that was absolutely unknown a few years ago—10,000 volts, when we started in Sacramento, was a terrible thing. I remember we put the transformers in a sort of a hut in the end of the power house, with skull and cross-bones over the door. We would not go within five feet of the transformers with the current on. Ten thousand volts is today practically low distribution. All over southern California there is run iron wire on ordinary pony glass insulators to furnish current to pumps at 10,000 volts. I don't know whether they tap the line when it is alive, but they have almost reached that state. We are gradually working up step by step. We are making better and better transformers. We have to. We don't know how high we can go. The problem of long distance transmission is simply one of dollars and cents and the market you can reach. I dont think we know our limit. I think the man is very foolish who predicts that the limit has been reached, and that we are anywhere near the limit of transmission, But depreciation, as I have said, is not so much the wear of the apparatus, because we can and do make better apparatus every year. We are making transformers that won't burn out continually. We are making generators that won't burn out. But the electrical apparatus of today, in my opinion, will be obsolete within ten years.

THE PRESIDENT. My own experience in our plant is—or rather my calculation—I admit it is not an exhaustive one, and perhaps not of any great value, but I have a general idea that our depreciation has been each year 7½ per cent., taking the whole plant all through. I would like very much to get the estimates of others who are engaged in this kind of work. Is it higher or is it lower than 7½ per cent.? That is a very important question.

MR. EASTWOOD. I believe this matter of depreciation depends on the class of installation in the first place. In any plant we will have two charges that will offset each other to a considerable degree. One will be the interest charge on your investment, which is determined by the class of investment, the class of work that you put in, which again will offset the depreciation charge. For instance, in work such as was put in on the San Joaquin Electric Company's power house. There we have a considerable investment in the power house; but I would like to see anyone point out any great percentage of depreciation on the power house of the San Joaquin Electric Company. The electrical apparatus is built on such lines that there has been no apparent depreciation up to the present time, as the generators have practically not cost anything for repairs or renewals, and they seem

to be at the present time in as good condition as when they were first installed. As to the matter of apparatus becoming obsolete, we have an offset against the necessity of removing obsolete apparatus in the gain in efficiency of the new apparatus that we install, so that we ought to give the depreciation account a little credit for the advances we make in the output and the benefits we derive by having new installation of apparatus. For instance, if we make a change in the type of water wheel or nozzle, by which we increase very largely our output of water that we use, it can readily be seen that we are increasing the size of the plant very largely by the investment of a very small amount of money in renewal of an obsolete portion of our plant, and for that reason we cannot charge all of that old apparatus that has been obsoleted to depreciation. There are certain parts of a transmission plant, it seems to me, on which we can count the percentage of depreciation almost absolutely. One of those is the pole line; that is, the poles themselves. We know that a pole will last so long, and no longer—that a safe limit would be twenty years. That would give you 5 per cent. straight for your poles. We know that a flume will last about seven years—that will give you another percentage for that portion of it. In addition to that we must always take into account, in the matter of depreciation, that to renew these decaying and disappearing parts costs a great deal more money than to put in the first installation, and for that reason the depreciation on a flume would probably be 15 to 20 per cent. On a pole line it would be about 5 per cent.; that is, on the poles themselves. The depreciation on copper is practically nothing. The depreciation on the power house, in case it is properly built of the right material, is very low—1 or 2 per cent. would cover it. The depreciation on the electrical apparatus would be probably 3 or 4 per cent.; but taking it through a term of years, and counting in the fact that this apparatus sometimes becomes obsolete, or some portions of it do. For that reason it seems to me that the depreciation charge against a plant is such a composite one that it is the same as Dr. Van Norden's proposition that each individual plant must be taken by itself, and the depreciation figured according to the class of construction that we have put into the plant in the first place.

THE PRESIDENT. I would like to ask Mr. Eastwood, if he is willing to answer the question, what, as a matter of fact, he has found, on rough calculation, the average and general depreciation of a plant to be? Suppose the plant cost $100,000; what percentage of it depreciates each year? Suppose that his concern were going to build a new plant, what would he calculate the factor of depreciation to be?

MR. EASTWOOD. I should say if I were going to build a new plant, and had the say as to how the plant should be built, I should cut the depreciation charge down very low.

THE PRESIDENT. How low?

MR. EASTWOOD. I should try to build the plant so the depreciation charge and the investment charge would equalize themselves; possibly not have the depreciation charge over 2½ per cent. per annum on the whole plant.

MR. POOLE. I can hardly reconcile the statement Mr. Eastwood makes in reference to the depreciation on flume and poles. I cannot conceive how a flume, elevated in the air, should depreciate quicker than poles, planted in the ground. I would like, for one, to hear from Mr. Robert McF. Doble on that subject.

MR. ROBERT MCF. DOBLE. I would only say in regard to that, Mr. President, that I quite agree with Mr. Eastwood on the majority of the points. We should bear this in mind, however, the calculation of the depreciation factor is a composite one, because, for instance, in some plants you have more or less flume, and in some more or less ditch; in some the pipe line is longer, and in others it is shorter. Then, again, the transmission line is longer or shorter. So that I think it would be very difficult, indeed, to establish any rule that would apply to all plants. As regards the life of the flumes, I would only say this, that experience on mining flumes has shown that in many cases they remain, not perfectly good, but good enough for service, for a period as long as twenty years without any extraordinary expense for renewals. There are cases where they don't last quite so long. There are cases where they have lasted a very much greater length of time. I think the experience with flumes on mining ditches is probably the best experience that is obtainable on that point. I think, as far as the pole line goes, with the exception of the cases where they have light, cheap poles—that is, sap poles—that nobody knows just how long they are going to last. That is, take a first-class sawn redwood pole, I don't know of any cases where they have had to be replaced; but the life of the flume seems to me, unless it has been very poorly constructed and on a bad foundation, a flume ought to be good for at least fifteen years.

MR. DONALD H. FRY. In regard to the length of life of redwood poles, I would say that that depends, I think, on local conditions a great deal, and also on the treatment of the poles before they are put in the ground. I have gone over pole lines and tried butts after they have been in four or five years, and found that poles in exactly the same kind of ground will vary alternately, almost—one will be rotten and the next one will be sound. Those that have been treated will last a great deal longer. When a boy in Humboldt County I found that some redwood fence posts rotted off in two or three years, while some had lasted for over twenty years, and were still sound. Almost invariably the sound posts were top-heavy; they were butt cuts, and the top ends (as the tree originally stood) were in the ground. I am not sure, but I believe the histological structure of wood is such that moisture is readily sucked up, but on the other hand minute valves prevent moisture from flowing down. This would be especially true in the redwood, where the "head" of the sap is exceedingly high. Of course, the condition of the wood when cut is an important factor in the future life of the pole; but another factor is the way the pole is set. That is, the top end of the tree being placed in the ground, the life of the pole is increased; for with the butt end down, moisture is more readily sucked up, and the timber at the surface of the ground (where rot invariably first occurs) frequently passes through that stage of moisture and temperature where it is susceptible to the germs of rot. I have found treating the butts of poles properly before setting them adds very materially to their life.

THE PRESIDENT. We have a line of some forty-foot poles that after seven years are found in excellent condition, and after they get to be five or ten years older I am going to saw them off and drop them five feet, and after that make thirty-foot poles of them, and I believe I can make those poles good for twenty years.

MR. POOLE. Are those round cedar?

THE PRESIDENT. Washington cedar, We recently, when the weather was very dry indeed, sent a gang up the line and dug the earth away and straightened up the poles, and anything that had rotted on the outside we washed with carbolineum, and retamped the poles, and I don't think we are going to have any trouble with those poles for five or six years, and then it is only a question of cutting them off and dropping them five or six feet.

MR. EASTWOOD. In reference to redwood poles, the difference in the lasting quality of the pole depends on the condition of the tree from which it is taken. While we were building the Hanford extension for the San Joaquin company, I had occasion to accept an invitation of the people that were furnishing the poles to visit the woods, and there I discovered that every now and then they worked in a tree that had stood dead in the woods for about twenty years, and whenever we got a pole that was cut out of a dead tree—we have taken out some of those poles on that line that were entirely dry-rotted off at the butts that were only in four years. I think that in most every case you will find a pole that will rot out that way will be taken out of a dead tree.

MR. LIGHTHIPE. I think Bakersfield has had probably the worst experience with redwood poles. They practically renewed almost their entire line within four years, and the fact is the poles began to rot before they were in two years. Whether this is due

to the peculiar soil at Bakersfield, or whether it was a bad set of poles, I don't know. They have had a very poor experience with them.

THE PRESIDENT. Mr. Carter, a pole expert, has just come in. Perhaps he can give us some ideas on the subject of the lasting qualities of poles. We have been discussing the question of poles in a pole line—the lasting quality of poles—and we would like to have you give us your ideas as to the poles that are most durable and suffer the least depreciation.

MR. GEORGE E. CARTER. I can give you my opinion about it.

THE PRESIDENT. That is what we want.

MR. CARTER. There are very few here who have not heard me on the subject of the lasting quality of a pole. I think you nearly all know my opinion about it. It is awfully hard to say off-hand which is the best pole to put in the ground in California, because there is such a variety of soil. I have known of soils that anything would rot in. There is one location in the San Joaquin Valley which is very sandy and where it is very hot in the summer time. I have heard such telegraph men as Mr. L. W. Storror and Mr. Frank Jaynes express their opinion on the subject, and they say that even iron would rot in the ground—that is to say, it would rust in the ground. The lasting quality of redwood is supposed to be, under favorable circumstances, about forty years. I don't believe there is a pole in California, of any kind, that has been in the ground that length of time. In the north, around Seattle and Tacoma, they claim that the cedar will last there at least thirty years in the ground. As those poles are cut for the California market, I don't believe that any of them, as they are supplied to the customers here in this State, will last anything like that length of time. I have known redwood poles to rot in four years, and cedar poles in much less time than that. There is cedar in California that does not last any length of time at all. It is called the blue cedar. In many cases it would not pay the expense of putting it in the ground. There is another cedar in California that grows in a high altitude that I understand will last almost as long as the northern cedar. But as for me to give any idea as to the lasting qualities of either one of the woods, it would be almost impossible. Nobody can tell anything about it. In the first place, the redwood, as a general thing, is not cut with the care for a pole that it should be cut. The commercial length of redwood is from twelve to twenty feet, and the mills generally have that length of pole in their ponds. Redwood to be cut for a pole of course will have to be a sap cut, and as a usual thing the order is placed when the parties needing the poles are in such a hurry for them that really they don't give the mill the proper length of time to get out the character of redwood for the pole that they should have, even if they wanted to. Usually the order is placed with the promise to deliver in a certain number of weeks, and the mills, in order to make their word good, or as near good as they can, will cut most any kind of redwood that is available. The time of year has a great deal to do with the lasting qualities of both woods. They should be cut when the sap is out of the tree. In redwood trees the sap in a measure preserves the wood, yet the lasting quality of the wood is very much better where it is cut in the fall or winter months. As for the best pole to be used in this State, there are too many things to be considered. In the first place, there are certain freight conditions that will bar redwood from entire sections. Frequently round cedar poles can be landed at a price that one would have to pay the railroad company for freight. Of course, under those circumstances, it would pay to put a pole in the ground that would not last so long, and it would cost very much less in the course of ten or twelve years. The locality always has to be taken into consideration. As I say, some localities are more favorable to the lasting of poles than others; but there is nothing that any man can go on with any degree of certainty as to the life of either one of these woods.

THE PRESIDENT. We have redwoods that have stood for eight years, and are in very fair condition, though they are not in as good condition as the Washington cedars. We consider the Washington cedars superior to the redwood, but our redwoods are really in good condition after eight years of service, and all the poles we have used have had a very much longer life than the pins and insulators and various forms of dressing of our poles.

MR. C. H. PENNOYER. The Pacific Telegraph and Telephone Company has just been taking out a line of poles along the marsh in San Mateo County, and I think all of those poles have been in at least twenty years. They have a very thick coating of moss on the north side. The telephone company is using them again; in fact, we have borrowed some of them and used them, and they are in very fair condition, and the only place where there is any great amount of rot is right at a line with the surface of the ground, where there has been alternating drying and moisture, and they are using those poles over again, and I know that they must have been in there at least twenty years. They are redwood sawed, square redwood poles.

MR. CARTER. I know of gate posts that have been in the ground for over thirty years.

THE PRESIDENT. We have discussed this question pretty fully; perhaps there are some others that we should discuss. I should like to hear something with reference to the very vigorous agitation that is going on in the State in favor of the expropriation by the public of the wheat ranches and the water rights and the reservoir sites and the drops that afford power. There is no question about that being a very lively agitation. These men have blood in their eye. They will look you right in the face and tell you that they are going to take your property.

MR. POOLE. If there is any real danger of anything of that kind hapening, I think it behooves this society to take concerted action to head it off; but it appears to me that it is largely a legal question, as to whether it would be possible for them to do it according to law, or whether they could succeed in having laws enacted that would give them that power. I think if it comes to a matter of legislation, we ought to muster up sufficient influence to keep it out of court.

THE PRESIDENT. It is very evident that the very great prosperity on the part of our industries will tempt politicians and agitators to attempt to get possession and get the profit themselves, or divide it among the people. Is there any other practical subject that bears upon our commercial success, directly or indirectly, that is of interest to any person? If so, it is a very good time to discuss any question of that sort that bears upon the commercial success of our peculiar form of business venture.

MR. GEO. P. LOW. There is one subject that seems to be pertinent, and which is overlooked in a way that is inexcusable, perhaps. That is the matter of personal liability; liability on the part of the public and liability on the part of the companies, for injuries inflicted by reason of accidents. The question of electrical accidents is so complex that it seems difficult to fathom the causes or the results of electric shocks. It is one that, however reluctant we may be to discuss it, we must face and bring about something that would tend to mitigate the evil. That was a point touched upon in the president's address which I think should be discussed.

THE PRESIDENT. We ran along for seven years without accident and without insurance, and then we thought it wise to take out an accident insusance policy, and the ink on the receipt was hardly dry before we had a case which the company, of course, had to fight and compromise.

MR. POOLE. The experience that we have had as to accidents from high voltage lines is that they are nearly all traceable to gross carelessness, and I think that one of the best ways to prevent things of that kind is to educate the people—those who have to handle either our own wires or our neighbor's wires—to be careful. I can recite an instance that occurred a short time ago on our line. The Western Union Telegraph Company was removing an old line that was directly under ours, probably about six feet distant. One man climbed up on a Western Union pole and stood up on the cross-arm, and, as near as we could learn, touched

his shoulder against a 40,000-volt line. He was knocked down and quite severely burned; he recovered, however, and was out again in about four or five weeks. About three days after he was injured, the same gang with which he was working had untied a stretch of wire, about four or five pole lengths. The men were on the ground, and they were pulling in and reeling up the old wire. The slack end of the wire accidentally caught, and the pull on the line threw the iron wire up in contact with one of our wires. The result was a shock. None of the men were seriously injured; they were simply burned a little, but they quit the job and wouldn't have anything more to do with it. It only goes to show that it is simply the result of carelessness in the majority of cases. I think as time goes on people will have a proper appreciation and respect for high voltage lines.

MR. EDGAR E. STARK. Some time ago, when I was in New York, in a station there, we made a set of rules that at the time we thought were best, governing the caution to be taken in handling dynamos, wires and transformers. A set of these rules were printed, and upon their back was a blank place left for the signature of the employee, and it was compulsory for every employee to read these rules and to sign his name to them, as having read them and understanding them. Thereby it was thought by the company to relieve it of some of the accidents. The main benefit from a rule of that sort, it strikes me, is to call to the attention of the employe the danger that he undertakes when operating for the company. It seems to me that this society could get up a set of rules of that sort that might be of value to us.

MR. LOW. What was the legal status of those rules?

MR. STARK. They were formed first by the accident insurance company; they were printed at their request.

MR. LOW. Would they relieve the company of liability?

MR. STARK. We were insured at the time by an accident company, and they suggested that as a means——

THE PRESIDENT. Do you know whether in any court where a case of accident damage was up, whether the fact that such rules were used and signed with any protection to the company?

MR. STARK. In a particular case there was one death about a year after the rules were made, and it was caused by a man leaning against the field coil of an arc machine while oiling it and the damages quoted by the court were very small. In that particular case, I remember when the man signed the rules. He was an oiler of the company.

THE PRESIDENT. Would you be willing, being conversant with these facts, to draw up a list of such rules and to present them here in the form of a resolution, so that we could print them and get them into our report, to be used?

MR. STARK. I have not a copy of the original rules, but they were the rules of ordinary precaution.

THE PRESIDENT. Could you devise something that would be suitable?

MR. STARK. I think I could.

THE PRESIDENT. We could all do it; but what is everybody's business is nobody's.

MR. STARK. I will try to do that.

DR. ADDISON. Mr. President, I think about two years ago a lawyer by the name of Adams, living in Spokane, was traveling on a pass, on the back of which he had signed the usual agreement that governs that sort of passes, to the effect that the railroad company would be under no penalty for any injury which might take place. Adams was thrown from the train near Spokane and killed. Notwithstanding that signature of his a suit was begun against the railroad company for damages, and it has recently been decided. Perhaps you have noticed it. The Supreme Court of the State of Washington, I think, has decided that notwithstanding Adams had signed that agreement relieving that railway company of all penalties, he had no right to do so; that a man's life did not belong to himself to sign away. The Supreme Court has decided that the railway company must be mulcted for heavy damages. The case will probably go to the Supreme Court of the United States. I think it would be impossible, from what little experience I have had. I would say it would be impossible to get any kind of an agreement that an employe could sign that would relieve a corporation from damages; providing the employe was injured thereby in any way. I am not a lawyer, but I have been in positions where I have had to go over that particular question with prominent attorneys, looking for all sorts of ways to handle some of those very difficult questions, and I have come to the conclusion that about the only way to handle them is to make a good strong fight to ward off some of those cases that are promoted by shyster lawyers, and when you do get a real genuine case, settle it in the best way you can.

MR. POOLE. I have had occasion to get an opinion of an attorney on the same question. I have been advised that no matter what agreement an employe may sign, it does not lessen the liability of the corporation.

THE PRESIDENT. Wouldn't it mitigate the damages in the eyes of the jury or the judge?

MR. POOLE. I think the better thing to do would be to get up a set of rules and regulations, and I would suggest, by the way, that the chair appoint a committee of three to prepare that list. It is rather hard work for one man to do that. I would not suggest that as a legal paper, but simply something for an employe to sign, acknowledging that he is a competent man in the line that he is to be employed in. I think that would go further and have greater weight with a jury or court than a man binding himself legally, or apparently doing so.

THE PRESIDENT. Do you make that as a motion?

MR. POOLE. I make that as a motion.

[Seconded and carried.]

THE PRESIDENT. I will appoint Mr. Stark, Mr. Poole and Mr. Robert McF. Doble on that committee.

MR. MCADIE. Mr. President and gentlemen of the convention: I think it might be proper, while discussing this point, to add to those rules something that would give information to linemen and others as to how to act in the event of accident; some suggestions, say, as to methods of recovery; because we find in lightning cases that probably eight times out of ten people are not killed outright by the shock, and that is particularly true with high potential discharges. The victim is thrown into a state of suspended animation, if I may describe it that way, and it might be well for this association to get up a few precautionary rules as to what should be done in case of accident. The man must go to work at once to try to restore respiration. Of course, one of the rules which is laid down in the cases of lightning is to send for a doctor as soon as possible. The medical men understand how to go to work, but there are certain steps that even a layman can take, and which, strangely enough, will very often bring the victim back to life after a period of perhaps half an hour or longer of seeming suspension of animation.

MR. LIGHTHIPE. I would like to say to Mr. McAdie that I don't think there is a power house or station in the United States that has not such rules tacked up on the wall, and it is an art that is becoming more and more known among the boys themselves. Perhaps it would be better to have a sort of fire drill among them until they get used to it; but today there is always somebody among them who knows those few fundamental rules, about throwing a man back over the shoulders, and it is becoming rapidly known. Anything that we can do to make it become more so—a practice drill or something of that kind—would be a capital thing. Some time ago there was a man tied up on a pole on the corner of Eddy and Mason streets, in San Francisco, with a great crowd around him, and four or five policemen guarding the bottom of the pole, waiting for the ambulance to come. They finally did get the man on the sidewalk, and there he lay, and they

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THE JOURNAL OF
ELECTRICITY, POWER AND GAS

Devoted to the Conversion, Transmission, and Distribution of Energy.

PUBLISHED MONTHLY BY
THE JOURNAL OF ELECTRICITY PUBLISHING COMPANY.

Address all editorial communications
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Postoffice Station M., San Francisco.
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Official Organ of the Pacific Coast Electric Transmission Association.

Yearly subscription: Domestic, $2.00; Foreign, $2.50; Single Copies, 25 cents.
Subscriptions can not be begun with back numbers.

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Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as *The Electrical Journal*, July, 1895. Entry changed to *The Journal of Electricity*, September, 1895.

VOLUME XII OCTOBER, 1902 NUMBER 10

EDITORIAL.

TWO NEW TROLLEY SYSTEMS.

It is probable that a fruitful source of revenue from transmission service awaits development in the utilization of electric power for the operation of trolley-driven electromobiles over country roads for the haulage of freight and passengers. Thanks largely to the excellent work undertaken by the good roads movement, country thoroughfares are approaching perfection more nearly year by year, and as good, smooth roads are the first requisite to success in the operation of the "trackless trolley," as such lines have been termed, the good roads movement has paved the way for future business of no mean magnitude in more than a figurative sense. Take California, for instance, where there are hundreds upon hundreds of miles of the best roads that money can build or human ingenuity can devise. In California, transmission pole lines follow such roads for mile after mile (they are being followed less and less, however, and practically not at all in new work, because of insulator troubles from dust and malicious interference), and virtually all the best roads of the State are closely paralleled by transmission lines, from which abundant power for the operation of omnibus trolley lines could be drawn. Contracts have been awarded for the oil sprinkling of the stage road leading from Raymond into the Yosemite Valley. The pleasure of a ride in a luxurious trolley-fed electromobile over such a road, lying as it does through the ever-glorious foothills of the Sierras, would even rival the raptures of the Yosemite itself.

A recent publication* describes several systems of this nature which have been built in Europe. One of these systems is in operation near Berlin, Germany, and another one, the Compagnie de Traction por Trolley Automoteur, which is in operation near Paris, is quoted to have earned, last year, $32,513, at an expense of $16,111, showing a clear profit of $7304 on a system comprising twelve cars. The famous Corniche road, built by Napoleon I from Nice to upper Monte Carlo, is to be made more famous by a road of this character, which is now under construction, to be operated over it. In general, the cost of the overhead wire is stated to be about $2000 per mile, while the cars cost about $2000 each. The system is operated in practically the same manner as an ordinary trolley car in street railway service, with the exception that the motorman, in addition to handling the controller and brakes, must steer the car as well. On fairly level roads an electric motor of fifteen horsepower is sufficient to haul a twelve passenger car at a rate of from fifteen to twenty miles an hour.

However unsatisfactory these statements may be as to definiteness, the fact remains that enough is given to warrant a very close investigation into the subject. The omnipresent transmission line gives a source of ample power in almost every locality; the value of the product of the vine and the orchard of every section at all removed from steam railway service suffers for the class of transportation which the trackless trolley car would afford; the cost of track construction, especially for heavy electric railway service, is a most serious item, and its elimination would give feasibility to many a transportation project which otherwise could not survive. All welcome, then, to the advent of the trackless system, even though its coming sacrifices our worshipful single trolley and brings about a demonstration of success on the part of the double trolley system.

A second new trolley system, and one which promises to become prominent as a large consumer of transmitted power because of its direct consumption of alternating current, albeit only single phase, is the new system of electric traction for the operation of inter-urban roads, as noted in the recent announcement of the awarding of a contract for the equipment of an important inter-urban road with alternating current apparatus throughout. The road in question is the Washington, Baltimore and Annapolis Electric Railway, which is to operate a line from Washington to Baltimore, about forty miles in length, with a branch to Annapolis fifteen miles in length.

This contract marks a great step in advance that has long been awaited by engineers, both in this country and in Europe. In the ordinary method of operating street railways direct current is fed to the trolley line for the car motors. For city lines and densely populated districts the current is often generated as direct current, but for long distance inter-urban roads this would involve a cost of copper conductors entirely prohibitive. To meet the latter objection a system has been used thus far in this country involving the generation of alternating cur-

Street Railway Journal, Volume XX, page 170, August, 1902.

rents at high pressures of from 10,000 to 30,000 volts, and the transmission of the same to substations, where, by means of transformers and rotary converters, the current is supplied to the trolley wire as direct current at the usual railway voltage of from 500 to to 650 volts. The rotary converter substation, however, has always been an undesirable feature, chiefly on account of the cost of the apparatus and building and the attendance required. The plans that have been prepared to do away with this feature are numerous, but before this none have appealed to practical American street railway engineers.

In Europe the polyphase induction motor has been used to some extent, but it implies the use of two or three overhead wires, and, moreover, the characteristics of the induction motor in regard to starting and average efficiency in railway service are said to be not of the best. Other systems which have been proposed involve the use of single phase motors upon the cars driving generators, which, in turn, supply power to the motors on the axles. However, this involves the placing of a substation upon the car itself, and so cannot be considered a great improvement over the ordinary alternating current direct current system. Details regarding the new system of the Westinghouse Company are not at hand, but it is known that by its use the limitations of the induction motor and the disadvantages of the multiplicity of overhead conductors, as well as the great cost of the system just described, will be avoided.

For the road which is now being constructed between Washington and Baltimore, single phase alternating current will be generated in a main power house, located at Hyattsville, by three 1500-kilowatt single phase Westinghouse generators, delivering current at 15,000 volts, and driven by cross-compound Hamilton-Corliss engines. This station is of more than average size, and is in no sense experimental. The power house will be built of brick, with stone and concrete foundations, and will contain, in addition, two 125-volt direct current generators, to be used as exciters for the alternators, and a large switchboard with electrically operated oil switches, circuit breakers, lightning arresters, etc. Current will be distributed from the power house at 15,000 volts to transformer stations located at suitable intervals along the line. These transformer stations will contain only stationary transformers, with the necessary switches and fuses, but no moving machinery, and will therefore not require the presence of an attendant. From these stations current will be fed to the single trolley wire at 1000 volts. The pressure of 1000 volts which has been adopted for the trolley wire is not a necessary part of the system, as a much higher voltage could have been used if it had been deemed advisable by the engineers of the road.

The cars will probably be sixty feet in length and weigh about fifty tons each. They will be supplied with master car builders' trucks, designed for high speed, the track is laid with eighty-pound rails, and it is expected that the distance of thirty-one miles will be made in forty-five minutes, including stops. The cars are to be equipped with four motors, each of 100 horsepower, and it is expected that a normal speed of forty to forty-five miles can be attained and a speed of sixty miles reached when necessary. The motor, which is the novel part of the equipment and the key to the entire system, is a variable speed motor, which it is claimed possesses characteristics adapted to railway service, and is in all respects equal to the present direct current railway motor. It has been developed and tested in severe service during the last few years by the Westinghouse Electric and Manufacturing Company, under the supervision of Mr. B. G. Lamme, assistant chief engineer.

It is to be remarked that this latest development in electric railroading follows in a path already traced by lighting. The first electric lighting systems employed direct current at low voltage, but as the area to be supplied increased, this involved an additional cost for copper cables. To meet the difficulty alternating current distribution at high voltage was adopted, with rotary converter substations to enable the current to be distributed on the existing mains as direct current. However, most electric power plants now being installed distribute low voltage alternating current directly to the lamps and motors, thus avoiding the expensive rotary converter substations.

HAVE CORPORATIONS SOULS?

On the morning of September 10th the traveling public of San Francisco made the acquaintance of the new transfer system then adopted on all the lines of the United Railways; by noon it was still studying over the innovation; at the close of the work-day it had further experience, so that by dinner time it had made up its mind that for genuine fairness and liberality toward the public the management of the principal street railway system of San Francisco had done an exemplary thing. This matter of the transfer system is virtually the first one which has been so presented as to enable the public to determine to its own satisfaction the attitude of the new corporation toward its patrons, and the latter have become convinced beyond question that they have now secured every transfer privilege for which they could in any shadow of reason ask. In brief, one may now transfer from any line of the United Railways to any other line under the same management, so long as a continuous or even transverse direction is maintained, and so long as there is no "doubling back" possible. The transfer service of the United Railways is most liberal, equitable and effective, and the San Francisco public is, for the first time, at peace and contentment with its principal railway system.

Instances of the administration of the affairs of great corporations in a spirit of liberality toward the public are becoming more and more common; in fact, liberality of this nature is becoming recognized as a policy which is inviolable in the attainment of greatest success. The

inauguration of this new and highly satisfying transfer arrangement is merely incidental evidence which brings home to San Franciscans the fact that ideas concerning the management of corporations have been undergoing evolution, that public sentiment and public rights are being given greater and yet greater consideration as time goes by, and that present tendencies will eventually, if they have not done so already, give the lie to the popular impression that among the great corporations of today there is hardly to be found a single one which is not a modern Frankenstein.

FROM A BUSINESS STANDPOINT.

It is with great pleasure that we announce the incorporation of this publication under the name of THE JOURNAL OF ELECTRICITY PUBLISHING COMPANY. On the 5th of September articles of incorporation were filed with the Secretary of State, with an authorized capital of thirty thousand ($30,000.00) dollars, twenty-five thousand ($25,000.00) dollars of which was subscribed. The balance of five thousand (5000) shares was reserved as treasury stock, on which THE JOURNAL OF ELECTRICITY PUBLISHING COMPANY guarantees an income of 6 per cent. per annum. The treasury stock, we are more than pleased to say, has nearly all been placed, showing the confidence our friends and supporters have in THE JOURNAL as a paying property. It is only necessary to say in connection with this, that Mr. George P. Low is president of the company, remains as editor of the paper, and will devote his entire attention hereafter to the reading columns of THE JOURNAL. The business department remains as heretofore.

By reference to the date line of THE JOURNAL, and to the heading of the editorial column, it will be noted that from this month the price of THE JOURNAL has been increased to $2.00 per annum for subscribers in the United States, to $2.50 abroad and a single copy to 25 cents. This advance has been made necessary by the increased cost of producing such a high class publication, and we have no doubt but few of our friends will object to retaining THE JOURNAL at the new figure. At the old price of subscription it would be impossible to carry out the line of policy which we have adopted for the future, toward increasing the value of THE JOURNAL to its readers and advertisers in such a measure as we have in view.

We feel justified in taking this stand from the many complimentary letters received from our subscribers within the past few weeks, and in justification of it, cull extracts from a few of the letters received.

The Utah Light and Power Company, Salt Lake City, under date of August 26th, states that "THE JOURNAL is already our standard on transmission work. It brings out the practical side of this work as no other magazine does."

Mr. George D. Shepardson, professor of electrical engineering of the University of Minnesota, Minneapolis, under date of August 28th, says that "We value THE JOURNAL highly as the standard source of information about the actual working of high potential systems. I wish to congratulate yourself and your readers on the added force acquired."

Mr. H. P. Reed, foreman of the Truckee River General Electric Company, under date of August 23d, states that "Your paper has been one of the greatest interest to me in every respect."

Mr. W. E. Goldsborough, chief of the department of electricity of the World's Fair, St. Louis, expresses the opinion that "A great deal can be done by your JOURNAL in stimulating Western companies to make exhibits at the St. Louis World's Fair. It would be a fine thing to have the electric transmission of power companies all represented here by exhibits, as both the engineering and general public, as well as many of our financiers, are greatly attracted by all that is transpiring on the Pacific Coast in the way of electrical development. I am sending you with this a blank application, and suggest that you put your JOURNAL on record as desiring space in the electricity building."

Mr. Fredrick A. Hannah, an eminent mechanical engineer, whose office is at 156 Fifth Avenue, New York, under date of August 14th, says that "I have found THE JOURNAL OF ELECTRICITY, POWER AND GAS very interesting, and enclose subscription for one year, to begin with the July number."

Mr. Charles H. Baker, president and general manager of the Snoqualmie Falls Power Company, regarding the article appearing in a recent edition of THE JOURNAL covering the installation of that company's plant, says, "I desire to congratulate you upon the excellence of the treatment of the article, particularly in the matter of illustrations and press work. Of the several write-ups which have occurred in different magazines and papers concerning this enterprise, yours certainly elucidates the situation more clearly and holds the average reader in a manner that none of the preceding articles could possibly do."

Mr. Edward P. Burch, consulting electrical engineer, of Minneapolis, Minnesota, in a recent letter, says, "Enclosed please find subscription for 1902 and 1903. I cannot get along without this valuable Western news, and papers, on power transmissions."

These extracts have been taken from letters picked up at random in our recent correspondence, and the additional revenue received from the increased price of subscription, should enable us to more than compensate our readers for the small additional outlay they are called upon to make.

In the August number we had occasion to refer to some of our new advertisers. By these columns it will be noted that we still retain them, and trust they are in THE JOURNAL to stay. Since that time, it will be noted that the following firms have come in as new patrons, or have increased their space to a very valued extent.

The California Electrical Works has a full page, which will be continued indefinitely, and will be augmented in the January number by a page in our illuminated cover.

The Crouse-Tremain Carbon Company, of Fostoria, Ohio, represented here by the Brooks-Follis Electric Corporation, places its production before the readers of THE JOURNAL in a half page introduction.

The Electrical Engineering Company, in this city, the Standard Electrical Construction Company, and the California Automatic Telephone Company have favored us with initial space advertising their enterprises, while among the engineers Prof. F. G. Baum and Mr. M. D. Spencer are the new arrivals, in addition to increased space taken by the Engineering Offices, 331 Pine Street. This information is given to our readers incidentally to note the progress we are making, and to call their attention seriously to the new advertising matter.

We will be pardoned, we know, for calling attention once more to the superb annual edition which will be published by us on the 1st of January next. For your information, we would say, that this number will consist of approximately 120 pages of interesting reading matter, enhanced by a great many new advertisements, all enclosed in an illuminated cover of very artistic design. It is not our purpose to descant now on the virtues of this special number, as we are content to leave others, after its publication, express their opinion of it. It does not, however, prevent us expressing our determined purpose to make this the most interesting number, both in reading matter and artistic workmanship, that has ever been turned out from our press.

This January JOURNAL will involve great additional expense, and it is not our intention to publish more copies than are actually necessary to serve our subscribers and those who desire extra copies. Orders for extra copies should be sent to the business manager before December 15th to insure their being filled, and copy for advertising matter we would ask as a special favor to have in our hands by December 10th.

Please bear in mind that hereafter THE JOURNAL will be issued regularly on the 25th of each month preceding date of publication, and delay in receipt of THE JOURNAL by subscribers should be promptly reported to our office.

We feel that from this time on a closer relationship between the publishers and its patrons will be an inevitable result of the increase in capital, consequently, power of THE JOURNAL, and the additional interesting matter that we will be enabled to place before our readers.

Let us have your assistance and hearty co-operation, and we feel assured that before another year we will be able to place before you a publication that will have no superior in the United States.

THE SIXTH ANNUAL TRANSMISSION CONVENTION.

(*Continued from page 195.*)

would not let anybody go near him. I tried to get in there. I told them who I was, and I got fired out of the crowd quicker than if I had not said anything. He laid there by actual count twenty minutes before the patrol wagon came there, with two or three policemen in, and they picked this man up and carted him off to the City Hall, the man being pronounced dead when they got him there. There was at least a half an hour between the time that man was caught and the time when he was put in the patrol wagon and carried off to the receiving hospital. I think it would be a capital idea for policemen in a city of this size to know something about the method of reviving people who are injured, or to be instructed to call for assistance from somebody. The policemen in this case immediately assumed that the man was dead because he was motionless, and they would not let anybody go near him; they simply kept the crowd back. Sightseers piled in and the policemen pushed them back. Four or five policemen kept that man lying on the sidewalk until the patrol wagon came. I think it would be a capital idea if the police force of large cities would know that the man is not dead at the time he is struck. The chances are that he is not dead, and if certain means and methods were understood, that man would be revived, the same as in cases of drowning.

MR. C. W. HUTTON. I think the points that Mr. Lighthipe has brought out are very important. In Sacramento there have been on our lines five men killed, and out of that number there was only one of them who was a lineman, and he was not working for our company. This information as to the means of resuscitation should be in the hands of the public more generally than it is now. As a general thing, if a lineman gets hurt there is somebody with him, or around, that knows something about it, and is able to work on him, but in the cases of individuals it is somewhat different. There was one case where a telephone lineman was up on one of our poles on which there were also telephone wires, and he was shocked from a 500-volt alternating current, and he was taken down and left lying on the ground until the patrol wagon came, and he was carried down to the station and pronounced dead, and they shook him up a little bit, and that was about all. There was no systematic method of working on him. We have had so many deaths in Sacramento on the different lines there that one of the local papers thought it advisable to impart the information necessary to be known to help a man out of trouble when he was shocked, and they published an exact duplicate of those charts that Mr. Lighthipe speaks of, and I have noticed that a good many of our power customers have cut that article out, and you will find it stuck around in a good many of the buildings. I think it is a very good thing. Another point that seems to be neglected, is that physicians, particularly the city physicians, should be posted on those matters. I think that in all cases in Sacramento our physician was very deficient in that respect, because in two or three cases it seems that the men did not have any show at all to be brought back, and it seems to me there ought to be some action taken to induce the different cities, where there is danger from these things, to insist on their city physicians being posted on that particular matter.

THE PRESIDENT. It is a question in my mind whether we ought not to have in all our power houses and substations a compound oxygen apparatus. In a city like Sacramento we can get that in a few minutes; it would not be necessary to have it in the substation; but at the power house it could not be obtained promptly, and it is a question whether compound oxygen should not be on hand in order to assist in the artificial respiration. I consider that a very important matter. Of course, the whole secret of resuscitation is in causing artificial respiration, the theory being that the heart has stopped pulsating, but it still fibrillates, still alive with a very slight movement, but not enough to preserve life, and what we want to do is to get the heart pulsating again, and the patient comes to; we do that by artificial respiration. A great assistant in artificial respiration is the compound oxygen, which is now used by physicians everywhere in cases of pneumonia, or wherever the lungs are acting very feebly indeed. It is a question in my mind whether we ought not to have this apparatus in stations, and I throw it out as a hint. Perhaps we will come to a point where we will require it to be done.

MR. FRY. I think that point about instructing physicians in towns where high tension transmission lines touch is a very good one, indeed. A case very similar to the one mentioned by Mr. Lighthipe occurred in Jackson nearly two years ago. A man

received a shock, and twenty minutes afterwards he opened his eyes, but nobody did anything for him and he died. I was in San Francisco at that time. After that I spoke to all the physicians in and about the county. One of them told me his plan, and that was to dig a hole in the wet earth and place the man in it "so as to take off all the electricity that was still in his body." [Laughter.] I think when one of the leading physicians of the county talks like that it is well enough to instruct them. Let every doctor know the fundamental rules.

MR. MCADIE. If I may rise a second time, I will state that the rules and regulations to which Mr. Lighthipe and Mr. Hutton refer, I take it, are those that were published in the *Electrical World* in 1894 and 1895, and which have since been reproduced more generally. I think it might be a very proper thing for this convention, and it would be in keeping with the spirit of that part of your address, Mr. President where you said that we already have a true scientific spirit and that there are no secrets here, and that we respect the honor of the scientist, if this convention would take up this matter and revise those rules—issue a new set of rules—because, as I have said, those rules are now certainly seven years old. Possibly we have learned a few things since that we can put in. We certainly handle voltages in California of 100,000, which were hardly dreamed of then. Thirty thousand volts seemed far away in those days. Possibly we have had additional experience, and more things are to be done, and therefore I make a motion, if I am permitted to do so, that the convention appoint a committee, of which the president shall be chairman, to take the matter under advisement, and, if it deems best, issue a series of instructions tending to show those who are likely to be hurt how to go to work to restore life in such cases.

THE PRESIDENT. I would suggest, before that motion is seconded, that we leave out that portion of it which refers to the chairman, simply for the reason that it would be better to have the committee composed of residents of this region, so that they can get together and consult the very best medical authorities in the matter, and can act. I am living in Sacramento, and it is very difficult for me to meet with a committee here in the city, and if Mr. McAdie will make the motion in that way, and it is seconded and carried, I will appoint him and two others who live in the vicinity of San Francisco on this committee, and they can frequently confer, and can also come in contact with the very best medical experts.

MR. MCADIE. What you said showed that you had thought over this matter a good deal, and you seem to be well posted on the matter. I don't wish to seem to force you into any position, but perhaps the convention can judge whether you are the right man for that place.

MR. POOLE. I think Mr. McAdie's motion is in order. I think the experience that Dr. Van Norden has had in these matters, and the practice he has had in connection with this work, will materially benefit whatever information we get or add to it. I now suggest that the committee be appointed, acting in conjunction with the committee already appointed, and make the report a part of the report called for by the first committee, and by circulating pamphlets containing these instructions, I think it will be of great benefit to the community and ourselves in general.

MR. MCADIE. I second Mr. Poole's amendment.

THE PRESIDENT. I don't quite get the force of that amendment.

MR. POOLE. I did not offer it as an amendment, although if it is proper to do so it can be considered as such. It is, that the committee to be appointed now act in conjunction with the previous committee appointed on the subject of instructions for employees, and that the reports of both of the committees be embodied in one report.

THE PRESIDENT. Let us simply refer this matter to that committee.

MR. MCADIE. I will make a motion to that effect.

THE PRESIDENT. The motion being seconded and carried, the matter is referred to the committee already appointed.

[Recess.]

AFTERNOON SESSION.

JUNE 17, 1902.

The Secretary reads a paper by Mr. Hall on "The Application of Electricity on the Comstock Lode."*

THE PRESIDENT. This paper is very able and very interesting, and is of great value to us. You will have perceived that without any suggestion from me. You have always refused to take any power of this sort, especially a mine hoist, because of the jerking of the voltage and the injury to the lighting system; but there are hints in this paper that encourage me to believe that such a thing will be possible for us in the future. We want to have a full discussion of this paper, and you can give to it all the time that you care to devote to it.

MR. FRY. The real reason that the mining operation has to be so steady is because of the concentrators. Stamps don't matter quite so much. How is the Comstock? Are concentrators a very important factor in the mill operations?

MR. HALL. We have nine Frue-Vanness in operation upon the same circuits with the hoists, and no trouble has been experienced therewith. The motors are not overloaded, and it takes considerable of a drop in voltage to lessen the speed perceptibly.

MR. FRY. We find a variable load in Amador; even 1 per cent. they object to; not on account of the stamps, but on account of the concentrators; but if the regulation can keep within 1 per cent. there is no objection; but if it gets much worse than that they are heard from at once. There is one question I would like to ask Mr. Hall, and that is about the location of the fans in the mine. Are they on the surface?

MR. HALL. The fans are all located in the mine, just as close to the work as possible. We have natural ventilation throughout the mine workings, and the fans drive the air from these to the working faces.

MR. FRY. The fans about Amador and Calaveras are usually located on the surface. They have a unique method there of changing them from an exhaust to a blower. They have a combination of gates whereby they can reverse the current of air, and this gives cool air down the shaft for a majority of the time, and just after blasting they change the blower into a suction and so exhaust all the gases and powder smoke.

MR. HALL. That is the same method that I have adopted in the Hale & Norcross tunnel.

MR. FRY. I would like to know about the two minute peak. Is that recorded on recording voltmeters?

MR. HALL. It is not recorded at all. We can't record it.

THE PRESIDENT. If there are any further questions to be asked of Mr. Hall I suggest that they be asked now, and then I will have the other papers read, and then we will have the general discussion of the whole matter of electrical hoisting. Are there any further questions to propound to Mr. Hall? If not, we will listen to the reading of a paper by Mr. Poole on "The Economy of Electrical Power in Quartz Mining."†

MR. FRY. Mr. Poole, in quoting Mr. Tregloan's article, stated that the power cost $270.00; that is for two months; so it is really half of what Mr. Poole said, which is a sixty-day test. I don't know whether he made the mistake or not. It is not very clear in the article in the *Mining and Scientific Press.*

THE PRESIDENT. Are there any interrogations? If not, before the general discussion, we will listen to the reading of the third paper, by Mr. Fry, on "Electric Pumping from a 1300-Foot Level."‡

MR. FRY. Mr. Hall is talking about the amount of water lifted. They have three pumps. Couldn't they attend to your work very

*THE JOURNAL, Volume XII, page 143, August, 1902.
†Page 126, July, 1902.
‡Page 110, June, 1902.

handily? Two of the three that you have installed, and handle the water?

MR. HALL. About the same. Two of the three pumps installed will handle the mine water alone, about 300 gallons per minute.

MR. FRY. There they don't need the reserve capacity. In some mines in El Dorado, pumpmen tell me, they are up to their waists in water trying to get the pump going, crawling up one button at a time. They can't get them in perfect condition. They get down a little ways, but they can never get the pump going perfectly. If they can't put in a large pump, or several pumps, or have water skips to help them out, they are in a bad way. They want large pumps, or a pump large enough to run only part of the time.

MR. STARK. What means have they in case of emergency of getting the pump or the water out of the sump, if the necessity should arise?

MR. FRY. The pump is on the 1300-foot level, in a place as dry as this room. The shaft is particulary wet. It would make you gag for breath to go down it; but the pump is thirty or forty feet away from the shaft, in a dry place. Most of the water is caught up above that section. The sump is on the 2000-foot level. They would have to fill that mine up before it would drown it. If they put another pump at the sump, they don't have to look out for it.

MR. STARK. In locating a pump in a mine, it has been the practice, particularly at Brown's Valley, to have it located at a lower level, whereas, in my opinion, they could have located a smaller pump at half the height and have saved three-fourths of the lift of the water; that is, in that particular shaft, most of their water is from a higher level, which is about 300 feet below, and they have located the pump at the 700-foot level. In that way, it strikes me, that some thought could have been put on it, and put in two pumps, and save in the installation in the first place.

MR. ROBERT MCF. DOBLE. With reference to the Oneida, there are no workings practically above the 1300-foot level.

MR. STARK. Where does the water come from?

MR. DOBLE. It works through.

MR. STARK. Do you put in dams?

MR. DOBLE. There are no workings in that part of the mine. I noticed some literature the other day on this same question of pumps in mines. The pumps and motors are placed in steel casings, absolutely water tight, and are arranged so that even if the mine floods, the pumps and motors will not be wet; and they provide an air pressure from the compressor within the casing and prevent any leakage of water within, or any collapsing of the casing. Some blueprints were sent to me a few days ago showing that application of electric pumps in deep mining, which might be a good arrangement in works of that kind.

MR. FRY. In and about Amador the mines are not very wet. Every vertical shaft is wet. We had rather a nasty experience splicing a cable 600 feet down, where it was raining pretty hard, and we had to keep it dry, and built a canvas house down there. But in that section I don't think they will ever have it flooded. Of course, it would be a good idea to house it in on the sump at the 2000-foot level, if they ever put in a pump down there, because there it might get wet; but as the mine is not a very wet one, as they can hoist 800 gallons at a skip, I dont think they need fear any trouble in that particular mine.

THE PRESIDENT. For the general discussion we have had three exceedingly able and lucid papers, of great interest, doubtless, to many who are present. The views are somewhat divergent; there is opportunity here for discussion. We will be very glad to have you not simply criticize the paper, but also to discuss the general subject of hoists and the proper apparatus to work them.

MR. EASTWOOD. I should like to ask a question; that is, why electric power has to be so heavily handicapped in order to get into use in these mines.

THE PRESIDENT. It takes people some time to find out things.

MR. FRY. I think that is because a good many mining superintendents are old men, and not used to that class of work. As the young men come up, they won't have the same prejudice to buck against. You will find the younger superintendents taking to electric power a great deal quicker than some old men. I think it is a personal equation.

MR. LIGHTHIPE. I would like to ask Mr. Poole, in comparison with compressed air and the direct application, whether he has made the comparison by kilowatt hours. Assuming that both were buying on the meter, whether it would pay to use compressed air or electricity for hoisting. I would like to see the comparison made. He has gone into the details against the use of oil and wood and coal, but I would like to see the amount of work done; the comparison with the amount of work done between the direct application of electric power and of compressed air.

MR. POOLE. I have prepared a few figures that touch upon this subject, and they work out something like this: .2375 British thermal units imparted to a pound of air will raise it one degree F. One pound of oil having 18,000 British thermal units, with a heater efficiency of 50 per cent., will give 9000 heat units to the air—

$$\frac{9000}{.2375} = 37{,}895 \text{ pounds of air raised one degree F.}$$

If we raise the temperature from 60 degrees F. to 360 degrees F. it will be increasing the temperature 300 degrees. One pound of free air at 360 degrees occupies 20.63 cubic feet, while at 60 degrees the volume is but 13 cubic feet; this represents an increase in volume of 58 per cent. If we divide 37,895 pounds by 300 we get 160, which represents the pounds of air that has been raised from 60 degrees to 360 degrees, and 58 per cent. of this represents the actual gain by reheating, which is 92.8. $13 \times 92.8 = 1206$, which represents the cubic feet of free air reheated to 360 degrees by one pound of oil. Assuming the air engine to consume twelve pounds of free air per minute horsepower, then the horsepower hours will be $\frac{1206}{12 \times 60} = 1.67$.

Oil at $1.50 per barrel will make the cost per horsepower hour $0.00269.

Electric power at $6.50 per horsepower per month equals $0.009 per horsepower hour. Assuming the combined efficiency of electric motor and compressor to be 50 per cent., then the cost per horsepower hour delivered by the compressor will be $0.018. Reheating this horsepower of air with a pound of oil, at a cost of $0.0045, increases the horsepower to 2.67, at a total cost of $0.018 + $0.0045 = $0.0225 — the combined price per horsepower hour $= \frac{.0225}{2.67} =$ $0.0084, showing a little more than 100 per cent. efficiency. From these figures it appears that compressed air can be delivered to the air motor at the same price per horsepower that is paid for electric power delivered to the electric motor driving the air compressor. That is like lifting yourself over the fence by your own bootstraps, but it figures up all right, and I think it can be demonstrated. These figures show more than 100 per cent. efficiency of the actual power delivered to the motor driving the compressor. While that cannot be realized in actual practice, we can easily figure on 75 per cent. of the actual power delivered. At that rate it would cost $1\frac{2}{10}$ cents per kilowatt hour delivered to the motor.

MR. LIGHTHIPE. I am assuming that in a certain part of the country the fuel bill is simply enormous, and I am assuming that electric power is available. If we use compressed air, can we reheat our air electrically with any economy?

MR. POOLE. Heating and cooking by electricity have always been considered a luxury, and while the efficiency shows up very high theoretically, in practice I don't know of any way of applying it to compare favorably with fuel oil at $1.50 per barrel. I

have not gone into figures on the subject, but taking what I have herad, it is not practicable to do it against those prices for fuel.

MR. LIGHTHIPE. I don't want to assume oil at $1.50 per barrel, because in certain parts of the State you can't buy oil at $10 a barrel. Take, for instance, the Four Hills Mine, where they have abundance of electric power, they would have to carry oil on the backs of mules ten miles. I don't suppose they could get a tank of oil up there. We made little coils for them to use to keep the exhaust from their air operated pumps from freezing. The coils consumed 200 or 300 watts, and they kept the exhaust perfectly warm, so that it would not clog up. The question came up at that time, would it pay under those conditions, where the current is very cheap and fuel very high, to attempt to reheat our air electrically?

MR. POOLE. I should say, under those conditions, it can be done, and done economically. Of course, when I stated that it was not economical to do it, I stated that on the basis of fuel oil at $1.50 per barrel. The ideal way to reheat air would be to put your reheating device right into circuit with the air just before the air enters the air motors. An electric heating device applied in this way would prove very satisfactory.

MR. HUTTON. I would like to ask Mr. Poole if the compression he speaks of is a double stage compression.

MR. POOLE. The computation that I have just recited does not make a two-stage compression; it is a single stage compression.

MR. HUTTON. What pressure?

MR. POOLE. Eighty pounds.

MR. HUTTON. How much better results can be obtained from two-stage compression?

MR. POOLE. Better results by 15 per cent. would be obtained by a properly arranged intercooler and two-stage compression.

MR. W. A. DOBLE. In installing a compressed air plant for maximum efficiency, the air should not be cooled in the compressor, but the compressor should be lagged the same as a steam engine. The pipes should be covered and the heat maintained, which is caused by the compression, and not thrown away, as the most serious loss in compression is the heat that you squeeze out of the air, in other words. By taking air and getting it hot and keeping it hot, you will secure all of the advantages without the reheating process; because in the arrangement you speak of there would be no reason why the compressor and receivers and the hoisting engine should not be close to each other, and no long pipes be necessary in which cooling would take place. Air handled in that way gives a decided advantage, because you save what otherwise becomes a loss of compression. If you take compression up to a point much greater than 100 pounds, then your internal temperatures would become great, and it would be difficult to lubricate your surfaces. But going to the problem of hoisting in mines electrically: I was over in Colorado the other day, and they are hoisting electrically there very satisfactorily with a 300-volt direct current and with rheostat control; but they are using their skips counter-balanced, so that the motor has to work whether it is hoisting or lowering, and in that way they are getting a very satisfactory current consumption per ton of ore hoisted by having it over-balanced, so that the motor works when it is lowering, and it is hoisting counter-balanced. It is the same scheme as used in passenger elevators. Another point which occurs to me on this electric mine hoisting is this, the mining companies have not been willing to install or to invest sufficient money to put in a suitable electric hoist. They are accustomed to buying boilers, brick work, smoke pipes and steam hoist, and they don't look at that; that is a necessary evil, and when you ask a mining company to pay a few thousand dollars for a suitable electric hoist, they are not inclined to do so. Of course, in all engineering processes, it is pretty safe to start in on the most direct course, because it is safe to assume that any transformation or any changes that we take up are bound to cost us something in heat units to overcome them. I speak particularly with reference to the variable voltage control in hoisting, such as the Ward Leonard or some of the other systems that are now in use, and with a properly installed direct electrical hoist, using a variable voltage system, the efficiency of the operating mechanism is then brought up to the efficiency of high-class electrical apparatus, which brings it much above the possible efficiency of a compressed air plant. This system has not been used in any mine hoist on the coast, except in one small installation, but it has been used in the East on duties which are even more severe, like in the handling of rolling tables in rolling mills. I think we can build a plant, designed properly, and that with the use of the variable voltages the control of the mine hoist can be handled with absolute satisfaction. Of course, that requires, taking it from an alternating current transmission, first an induction or synchronous motor driving a direct current generator. Then there would be a direct current motor attached to the hoist, so that it requires two additional electrical units, or pieces of electrical apparatus, so that the horsepower of apparatus installed would be practically 3 to 1. But the results secured are very satisfactory, because the current consumption is practically in proportion to the load handled, and the apparatus is exceedingly simple. Of course, there is another very satisfactory way, though not as good, and that is by using a series parallel controlling apparatus, such as is used on street cars, which gives fairly good results. There is one advantage in using the compressor, and that is that when your hoisting engine and boilers are on the ground; but ordinarily the hoisting engine is so inefficient that it would very much exceed the steam consumption that you mention, namely, approximately about thirty pounds. It is a very excellent steam hoist that will anywhere near approximate that. Then when you take into consideration the leakages that come into the compressors and engines of that type after they have been used, the steam consumption or air consumption materially increases, whereas by taking the same cost of investment and putting in a direct electrical apparatus, or, perhaps, even a lesser cost of investment, the results would check out, I believe, fully as satisfactory, or more so, besides having a simple plant instead of a composite one. The plant I speak of was tested on the Gottschalk Mine. That was on the Ward Leonard system, taken off the California Exploration Company's lines. I watched that ammeter while it was running, and the current consumption was almost absolutely in proportion to the work done, without any sudden rise in current consumption in starting the load.

MR. FRY. In regard to that, I don't quite see where the advantage would be over the system that Mr. Hall spoke of. There is three times the outlay, and three times the risk of breakdown, and practically the same variable load—not quite as variable, but very nearly, as the variation in the load as in the altererting device; and I don't see just where the advantage would come in. Another point is, that you not only increase your first cost of machinery three times, but you multiply your inefficiency. If you get 90 per cent of one, two a little over 80 and three is in the 70's.

I would like to speak about reheating the air. I think it is necessary to cool the air in a compressor. You cannot get too much receiver capacity. To insulate all that heat, and to insulate down into the mine shaft, I think it would be out of question in the first cost. So few of them realize what the receiver capacity amounts to. South Spring Hill is a small receiver capacity, to be sure, but it was large compared to the motor, and the saving there was exceedingly great. Of course, that case was a particular one, and it was well worked out by Mr. Tregloan, and fit the circumstances exactly. They saved $70 a month over and above the cost of the electric power; in fact, over $2 a day saved on the installation, and they were able to hoist three times the amount of rock with the same amount of labor, and the expenses were $70 less. It was merely a test, but the conditions were very unfavorable. It was an old type machine, taken out of a junk pile, you might say, and the conditions were anything but favor-

able. They did not have time to put the air piping into the boilers in perfect condition, but blew it in on top of the water; but at the same time there was a saving, and in that case it was a very nice installation, but a large mine would need an exceedingly larger receiving capacity. You don't all realize that, because the moment you are using air a little faster than you are producing it, then you use more—you multiply it and it runs right away from you. We had a thirty-horsepower motor, siphoned the water out of the tunnel, and she couldn't hold up; she would average about twenty-six horsepower night and day, and couldn't satisfactorily operate the one drill; it would get away from us. That same thirty-horsepower motor, running a compressor a little smaller, and using on the average twenty-one horsepower night and day, wouldn't run two drills, and the extra air went into the boilers and practically did all the hoisting through the day time. So the compressor was shut down, and Mr. Tregloan understood the situation very well, and got in receiver capacity enough. Fortunately he had it right there. So many mines put in ten times the compressor power—put it all in compressor and don't have anything in storage, and the hoist is variable. When she stops you are loading up your receiver, and if you have not receiver capacity enough she gets away from you, and you can't catch up again.

MR. LIGHTHIPE. Speaking about the direct application of direct current, Mr. Stark may tell us about several hoists in Grass Valley. I know of two that were installed there in series parallel, the power coming from a synchronous motor coupled to a direct current generator, and the direct current generator supplying the current for a series parallel hoist. I know of one, especially, in the Gold Hill Mine there, for which we made a very easy hoist—a very easy start, by putting in resistance in the field of the generator—a 500-volt generator—and we pulled it down to somewhere in the neighborhood of 200 volts. This generator was heavily over compounded, and in throwing on the series parallel hoist we started with a voltage of about 200 volts, and the machine compounded itself as the load came on, and made a very smooth acceleration. Of course, the bugaboo in all hoisting work is the acceleration of the heavy mass, the same as in street car work, and any method, such as the Ward Leonard system that Mr. Doble spoke of, that will take off this high peak in starting, is a great benefit both to the consumer and to the company that furnishes the power. There were several of these hoists, I think, installed in Grass Valley before we had properly developed a good variable speed induction motor. At that time the variable speed controller had not reached the place it had when Mr. Hall had charge of the Comstock installation, but it filled the requirements in several hoists. Of course, it complicated the apparatus, but I think if any tests were made it would show good economy. The series parallel controller for hoist work has been very ably experimented on in the Dunsmuir hoist. The first three hoists established there were made of a regular railway type of motor, with a rheostat control. The additional hoists were made with the series parallel control, and the watts per ton lifted from the hold of the vessel was just about one-half with the series parallel controller as it was with the resistance type. Of course, the lift is very short. It is the accelleration. Before you are through accelerating you are breaking, and in fact a great deal of our mine work is that way unless we have a long lift; we don't fully get up speed before we begin to slow down again, and anything in the way of hoist work, in direct application, we have to get a variable speed that shows some economy.

MR. POOLE. Referring to Mr. Doble's remark in reference to the compression of air in a compressor, his ideas are all right if you can use the air as soon as it is compressed, with this exception, that when you compress your air hot and keep it hot you increase the power required for compression.

MR. W. A. DOBLE. The fact is that compressors are being run compressing up to a pressure as high as eighty pounds, and higher than that, and running without any cooling whatsoever. I did not quite understand Mr. Fry's remarks as to conveying this air down into mines for any great length of pipe, or keeping that free from cooling, because, as I understood, we were discussing the question of mine hoists where the compressors and receivers could be close to the hoisting engine. If you are running with steam you lag your pipes and lag your drums and all to keep them hot, and I see no reason why, if you are running with compressed air, you could not preserve the heat that you necessarily must develop in it in the process of compression much better than to throw it away, even though your oil only costs you 1 per cent. or 2 per cent., you save that much, and it seems to me no huge difficulty. We do a great deal in the compressed air business, and I see no difficulty whatsoever in keeping the air hot, and with properly lagged receivers, which are very simple, it makes that much economy. It is being done in some places. The air is being compressed and the initial heat is maintained. Of course, for underground working, I don't believe that any air pump will equal the results secured from an electric pump. We have had enough experience with that to get very satisfactory tests from it, such as Mr. Fry mentions in the Oneida. Mr. Lighthipe will remember the old Gover plant; that was the first electric pumping plant, as far as I know, ever installed; it ran right along with exceedingly favorable results, and the cost of maintenance was very low. In fact, I tested the pumps at one time, and the current delivered to the motor was a little better than 75 per cent. of the theoretical power required to lift the water on a 500-foot single lift.

MR. POOLE. I don't want to pose as antagonistic to electric power for any purposes, but I do advocate that in the ordinary mining, as it is carried on today, especially with installations already installed, compressed air for hoisting purposes, to my mind, is superior to electrically driven hoists. The efficiency, I think, can be made fully as well by proper reheating and proper looking after the compressors and your hoists. I do believe, though, that the hoists should be somewhat reconstructed to get the best results. But the net results, I think, can be just as efficiently obtained by using reheated air and electrically driven compressors. The reliability is a very important factor, and when you talk to an old mining man about putting in electric hoists he is very skeptical. If he is away off somewhere where he cannot get anything but electric power, he will take it, but it is only as a last resort. He will take almost anything else before he will take electric power for hoisting purposes.

MR. STARK. As to the question of running hoists, and hoists only, I will go into the details of the plant that Mr. Lighthipe spoke of. That is similar to the Ward Leonard automatic arrangement entirely. The voltage on the direct current generator that is driven by a synchronous motor—it is at the Gold Hill Mine. The generator voltage is lower; the machine is somewhere about 10 or 25 per cent. over compound. The control is with two motors, multiple series, and as it starts in series the current is low and the compound is slight, and hence the boosting effect of that on the compounding makes a very slight draft on the alternating current synchronous motor. As the speed increases by cutting out your resistance the compounding increases, your voltage increases, and the speed of your hoist—the whole thing is beautifully automatic, and is not an infringement at all on the Ward Leonard scheme, and acts just as well.

MR. W. A. DOBLE. There is one thing I would like to speak about, and that is that receivers out of proportion to the size of the compressor make a serious drag on the system, that when your work is heavy you have a low pressure in your receivers, and your compressor has to have double work to catch up. That was found out at the Eagle-Shawmut Mine, where they use a great deal of compressed air. They found that after they increased their receivers over a certain size in certain portions of their work, the receivers became a detriment. It is just the same as they found out in rolling mill engines, as to the effect of the fly-wheel, that in rolling very long rails the fly-wheel is of disadvantage,

because as soon as it lost its inertia it became a drag on the engine. The receiver, if it is over proportioned, has that same effect. It becomes a drag on your compressor, and at the Eagle-Shawmut Mine they propose to now put in an automatic device, which is more on the principle of a hydraulic accumulator, where the receivers will be connected up to a column of water, and so as the air is used out the pressure in the receivers will be kept constant, and as the air accumulates it simply drives the water back up the hill, having the same value as an ordinary accumulator in hydraulic practice, otherwise as soon as the receivers begin to lose pressure they become a drag on your system.

MR. FRY. Very few mining superintendents put in too much receiver capacity. I think that might be overcome by a check valve.

MR. DOBLE. You lose your pressure in the receiver. If you have something that will maintain that pressure and give you the last air in the receiver at full pressure, you then use your entire receiver capacity to advantage, they are accomplishing it there by running a water pipe up the mountain, and with that they get a constant pressure on the air, no matter how little air they have in the receiver. Otherwise you draw down on your receiver, the air is of such low pressure it is of no value and becomes a drag on the compressor.

MR. POOLE. It seems to me that would be evidence of not having receiver capacity enough. If you have no range in working pressure the receiver is of no use whatever. If you have a range in the pressure, that is, working range, of course the receiver is useful so far as it will keep within that range, and to that extent only.

MR. DOBLE. But a receiver will hold a great many cubic feet of air, say at forty pounds, which would be too low to be of any value, whereas if that receiver is drawn down half way, if they could still maintain the pressure, which they do by water, then the full receiver capacity would be available.

MR. LIGHTHIPE. Wouldn't it be cheaper to use an accumulator, as is done with water elevators?

MR. DOBLE. Except the capacity may be limited; and friction and leakage would be a serious item.

MR. POOLE. I would like to ask Mr. Hall with reference to the measurement of their electric current used on the hoist. Did I understand it was by ampere-hour meter?

MR. HALL. At the present time there is no measurement taken at all. The contract is that we buy a thousand horsepower, whether we use it or not. Our consumption is less than a thousand horsepower, and there is no measurement taken. The electric current is supposed to be measured on a recording voltmeter, which would indicate the two minute peak load. Up to this time we have not been able to get an instrument that will do that.

MR. POOLE. Will it be a wattmeter?

MR. HALL. Yes, a recording wattmeter. In addition to that I have put integrating wattmeters at each installation, and from these I propose to divide up the consumption of power between the various companies.

MR. LIGHTHIPE. About four or five years ago I tried to get the General Electric Company and the Union Iron Works to build a hoist, using an induction motor on which the rotor and stator, as Prof. S. P. Thompson calls them, revolved in opposite directions, the tauts being equal and the speeds being equal, then both sides would belt on to a shaft with a bevel gear, after the style of the old Pelton differential governor. Both revolving at the same speed, the bevel gear would stand still; that is, the journal in which the bevel gear rested would stand still. This was connected directly to the hoist shaft. Then by breaking either the rotor or the stator of the induction motor, you could gradually accelerate the hoist in either direction. But nobody enthused over it, and we dropped it.

[Recess until 8 P. M.]

(Continuation in the ensuing number.)

INDUSTRIAL.

WESTON ELECTRICAL INSTRUMENTS.

WESTON instruments have been so long representative of the best type of electrical measuring instruments which science has yet devised that any new type of form which is brought out by the Weston Electrical Instrument Company at once commands universal attention. As has become the accepted practice among the best manufacturers, this company has begun to issue periodically bulletins of its products, the first four of which* describe new forms of Weston instruments that are bound to leap into popularity in the class of work for which they were designed.

The portable Type E direct current instrument is adapted for use in many circumstances where tests are to be made, but where the extreme accuracy which can only be obtained by the use of portable standard instruments is not not necessary or desired. They are suitable for use in institutions of learning, and are specially serviceable in central stations, where stray magnetic fields exist, as the Type E instrument proper is enclosed in an iron case which forms a shield against external magnetic influences, although care should be exercised not to subject the

PORTABLE TYPE E DIRECT CURRENT INSTRUMENTS.

instrument to powerful magnetic fields which would permanently magnetize the iron case.

The accuracy will be found sufficient to enable employees of central stations to check up their switchboard instruments, and in general testing, and the prices are so reasonable that any one having occasion to make electrical measurements need not be without a reliable instrument for the purpose. To be specific, the prices vary in voltmeters having a maximum range from 3 to 300 volts from $25.00 to $32.50, with $5.00 added when double scale instruments are desired. The prices of ammeters ranging in maximum scale from 5 to 500 amperes vary from $25.00 to $29.50, and it may be stated that the ammeters consist of milli-voltmeters adjusted with external station type shunts to read direct in amperes for all ranges above 25 amperes. The dimensions of these instruments are: Width, 8¼ inches; length, 8½ inches; height or depth, 4⅜ inches.

The Type K voltmeters and ammeters are small round pattern instruments, which have been expressly designed to meet the demand for good but low priced instruments for use on small direct current switchboards, such as are installed in connection with small isolated plants for lighting, power and other purposes, or for telephone, telegraph or other service, where a small instrument fully meets all requirements. They are the same in general construction and appearance as the well known round pattern Type F Weston instruments, which are so extensively used throughout the entire civilized world, but Type K instruments are

*Weston Bulletin No. 1, "Cheap, But Good, Portable Instruments"; No. 2, "Small Isolated Plant Instruments, Type K"; No. 3, "Duplex Instruments"; and No. 4, "Round Pattern, Type S, Instruments."

much smaller than the Type F, and are therefore better suited for small switchboards or for use in places where space is limited.

The dimensions of the Type K instruments are as follows: Diameter of front, 6⅝ inches; diameter of flanged base, 7¼ inches; total depth, 4 inches; length of scale, 5 1/16 inches.

The instruments are excellently made and are carefully designed so as to secure the highest degree of durability and reliability and economy of power in operation. They are absolutely dead beat, and their indications, with proper use, can be trusted to 1 per cent. The cases are well finished, and they are neat in appearance. The standard finish is black, japan and nickel, but these instruments will be made to order in any finish demanded at a slight advance in cost. They are not an untried instrument, for thousands of them are in daily use and are giving perfect satisfaction. The voltmeters are made in ranges from 3 to 150 volts and sell at from $15.50 to $17.00 each, while the ammeters, having maximum ranges from 1 to 200 amperes, sell at from $15.00 to $17.00 each.

STATION TYPE K DIRECT CURRENT INSTRUMENTS.

The round pattern Type S instruments described in Bulletin No. 4, have been designed to meet the requirements of the medical profession, dentists and others who need a very compact instrument for use in connection with the medical application of direct current electricity, and for other purposes where compactness, neat appearance and a high degree of accuracy is demanded. They are based upon the same principle as the well known Weston direct current voltmeters and ammeters. They are well made in every detail, with polished sapphire bearings and hardened, ground and highly polished steel pivots. They are carefully adjusted and calibrated, and their indications are trustworthy to within one-half of 1 per cent. They are enclosed in substantial cast brass cases, nickel plated and polished, and the finish and appearance will harmonize with the best kinds of equipment for the medical application of electricity. They may be mounted upon switchboards, desks or any apparatus with which it may be desirable to use them.

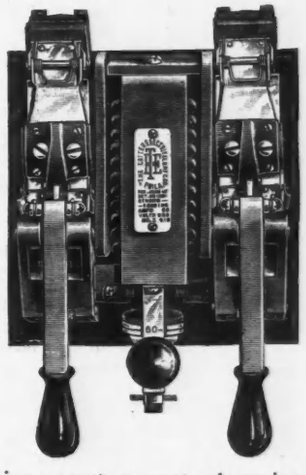
ROUND PATTERN TYPE S INSTRUMENTS.

The outside dimensions of these instruments are: Diameter of front, 5 3/16 inches; diameter of base, 5½ inches; depth of case, 3 inches; effective length of scale, 3½ inches. They are, therefore, much more compact than any other switchboard instrument we make.

While these instruments are expressly intended for the use of physicians, dentists and others having need for the use of comparatively low range instruments, they can be made of any range desired, above or below those given in the list. On account of their very small size they will be found useful for a variety of purposes outside of those specified, more especially in telephone, telegraph and other services where a very small instrument is frequently desired. Their prices range from $25.00 to $28.00 each.

A NEW TYPE OF CIRCUIT BREAKER.

THE latest type of circuit breaker, as manufactured by the Cutter Company, represented on this coast by Mr. John R. Cole, of San Francisco, is known as the Dublarm Type. This piece of apparatus is, in fact, a combined hand switch and circuit breaker. Heretofore the general practice has been to close the circuit breaker and then the hand switch, so that in case of an overload or short circuit the breaker would instantly open. The "I-T-E Dublarm" type dispenses with the usual hand switch.



This piece of apparatus is so constructed that either side of it may be closed first, and on closing the other side (thus completing the circuit), the breaker will instantly open if there is an overload or short circuit on the line. Both poles being closed, an overload or short circuit will open both of them simultaneously. They are specially serviceable for feeder protection on account of their compactness, not only saving the expense of switches and their connections but also allowing more feeders being placed on one panel by using the space formerly occupied by the hand switch. Being provided with a hand-trip, they can instantly be opened by hand, thus combining all the features of a hand switch together with those of a double pole circuit breaker. "Dublarm" types are made in all sizes and their cost is relatively low. This type of instrument was originally designed by the Cutter Company to comply with United States navy specifications. An illustration of this piece of apparatus is shown above.

REDUCTION OF SKIN FRICTION ON STEAMSHIPS.

A DEVICE invented several years ago by Mr. F. L. Binford, of Los Angeles, and now being brought to the public attention, promises to cut a great figure in transportation. It seems to be exceedingly useful in the reduction of skin friction on the hulls of vessels, a problem of vast importance and one which has heretofore baffled all the efforts of engineering skill. The result is accomplished by making a judicious use of solid as a substitute for fluid friction. As some of the best engineers even have not all the laws of solid and fluid friction at their finger's ends it may be well enough to remark that there are several important differences to be borne in mind. Solid friction is directly proportional to the pressure and independent of the velocity and the size of the surface in contact, while fluid friction is proportioned to the size of the surface in contact, independent of the pressure and increases approximately as the square of the speed. It is owing to the fact that the skin friction of steamships is in proportion to the size of the surface in contact and increases approximately as the square of the speed that it becomes in vessels at high speeds such an enormous resistance. It is by changing, through simple mechanical appliances, from the sliding friction of the water against the hull to solid friction that the result is accomplished. The nature of the device is such as to render sections of the surface of the hull, in fact practically its entire surface, movable under the action of the water. It is believed that this invention solves the long and much disputed question of th economical use of the jet propeller.

While possessing many acknowledged advantages, jet propulsion has long been considered out of the question on the score of economy by reason of the excessive friction caused by the high speed. By means of this device its economical use seems to be entirely assured.

There are several important uses already known for this anti-friction device, and it seems quite probable that its scope may soon widen to one of vast proportions. Its greatest field, however, seems to be in all kinds of transportation, both on land and sea. What experimental work has been done has been with a view of testing the principles involved. It takes a large amount of capital to make practical demonstrations in the main fields of its utility. Mr. Binford is temporarily in the city on his way to New York for the purpose of interesting heavy capitalists in the promotion of his enterprise. While it is well enough to be cautious in asserting the feasibility of an invention in any department of this busy world until it is proven by thorough practical demonstration beyond question, still such a prediction in the case of the present one, considering the endorsement it has received from men of the highest scientific attainments, would hardly be considered as being rashly made.

THE STOMBAUGH GUY-ANCHORS.

"The moving finger writes; and, having writ,
Moves on; nor all your piety nor wit
Shall lure it back to cancel half a line;
Nor all your tears wash out a word of it."
—*Rubaiyat.*

The verse shows that Omar Kayyam, way back in the Twelfth Century, knew the disadvantage of moving parts. He would have written the following had he known of the Stombaugh Guy-Anchor:

The moving parts wear out, and, having worn
It breaks; nor threats, nor all the curses sworn,
Can make it equal or compare with Stombaugh's
Guys; nor all the repairs nor all the scorn,

The Stombaugh Guy-Anchor will wear longer than the pole, stack or fence to which it is guyed. Why is this? The best reason, among other good ones, is that there are no moving parts to break, rust, bend or get lost. The Stombaugh Guy-Anchors are practically one piece, each being a wrought-iron rod, with a cast-iron helix, so constructed that it can neither turn nor pull out. The device is perfectly rigid.

To install the Stombaugh Guy-Anchor:

1. Remove two or three spadefulls of earth from the point where you wish wire guyed.
2. Fit the socket of the wrench to the key on the anchor.
3. Place the point of the anchor in the hole started by the spade and bore the helix in as you would a corkscrew into a cork.
4. Always put the anchor in at the angle you intend to run the guy wire.
5. Remove the wrench and attach the strand to the eye of the anchor.

The Stombaugh Guy-Anchor can be installed in five to ten minutes, and will not pull out except under enormous strain.

In a pulling test of Stombaugh Guy-Anchors made by Professor R. C. Carpenter of Cornell University, the following were the results obtained:

	Diameter in Inches.	Depth in Inches.	Maximum Resistance in Pounds.
In Sand	3½	30	3,200
"	5	40	5,800
"	6	40	6,600
"	8	40	9,000
"	12	48	18,400
In Clay	3½	30	3,200
"	5	40	4,000

GRIMES IS NOT DEAD.

THE Kansas City *World* relates how the problem which has led so many inventors astray has been solved (?) by a blacksmith by the appropriate name of Grimes. Mr. Grimes had spent twelve years in a fruitless search for the Perpetuum Mobile. He attended a concert, but the seductive strains of the music only incited his brain to greater activity in its strife with his problem. Suddenly an idea occurred to him. He left the concert unfinished, went hurriedly to his shop, and "after he had procured a spring he attached it to the machine."

"Breathlessly he watched the tiny wheel swing clear of the track until it struck the sharp part of the incline. Then with the saved energy he saw it mounting up, up toward the point that for twelve years had stood between him and the success of a fond ambition. Would it lag at the critical moment and crush his new found hope? No, it was over, it was rolling down on the other side! With the feeling of a discoverer of a new continent or of a conquerer of many armies, he sat down and feasted his eyes on the culmination of all the years of work and worry. Then he slept, and when he awoke next morning he wondered if it was all a dream. He looked at his machine. It was still running."

Commenting on this, *Power* observes that several previous inventors have solved the problem by the use of a spring. The last one concealed the spring in the base so ingeniously that it took an X-ray apparatus to reveal it.

SOME NEW OTIS ELEVATOR BUSINESS.

Probably the largest elevator contract ever awarded was closed last week by the Otis Elevator Company with the Metropolitan Life Insurance Company for the additions to their building, Fourth Avenue, between Twenty-third and Twenty-fourth streets, New York City. The new equipment consists of twenty-three high pressure passenger elevators, four hydraulic freight elevators and two electric passenger elevators, and contemplates converting the thirteen passenger elevators in the original building so as to operate them at the increased pressure. The plant, when complete, will consist of forty hydraulic elevators, operated from one pumping station. Messrs. N. LeBrun & Sons are the architects, and V. J. Hedden & Sons, builders.

30,000 HORSEPOWER IN PELTON WHEELS.

The Pelton Water Wheel Company reports having just closed a contract with the Vancouver Power Company, of Vancouver, B. C., covering three Pelton wheel units, with a combined capacity of 10,000 horsepower. The wheels are for direct connection to electric generators; the power to be used for electric railway and manufacturing purposes in the vicinity of Vancouver. As instancing the progress of electric transmission, may be mentioned the fact that the Pelton Company has under construction at the present time Pelton water wheels aggregating 30,000 horsepower, all of which are to be used in connection with electric transmission of power.

A COLOR CHART OF DIXON'S PAINT.

An ingenious card device for displaying the colors of Dixon's Silica-Graphite Paint in such manner as will permit of an exact idea of each color is being issued by the Joseph Dixon Crucible Company, Jersey City, N. J. The color chart carries with it suggestions as to the class of construction that can be protected with this paint, also instructions as to best methods of applying protective paint. The new color chart can be secured by request to the Joseph Dixon Crucible Company, Jersey City, N. J.

A NEW STORAGE BATTERY AGENCY.

The Century Electric Company, of San Francisco, has recently been appointed Pacific Coast agents for the Gould Storage Battery Company. Among the recent installations of this company is the plant installed for Mr. George W. Vanderbilt at his magnificent Biltmore estate, at Biltmore, N. C.

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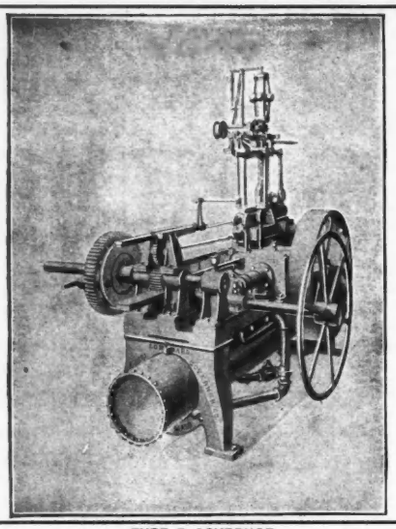

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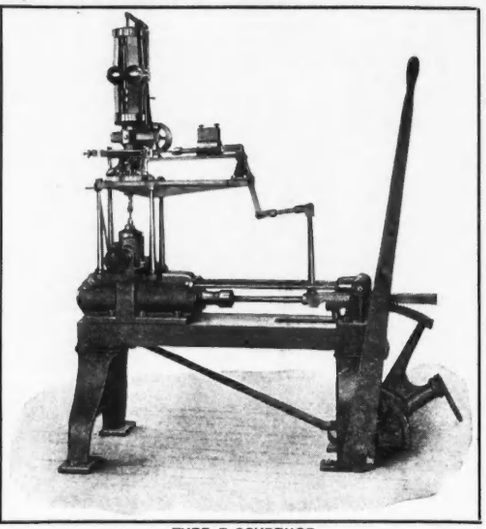

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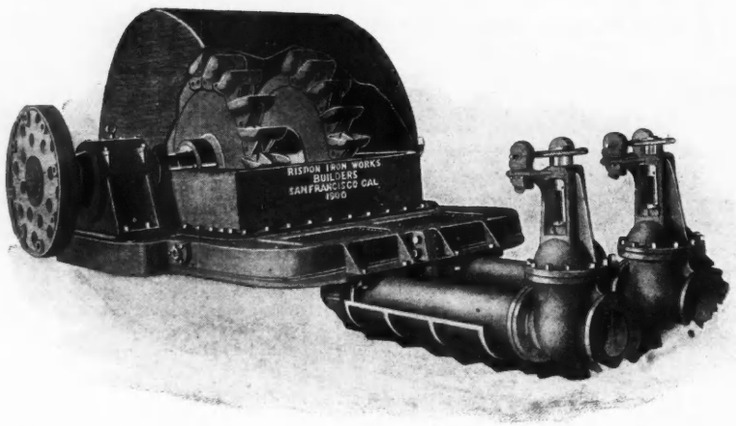

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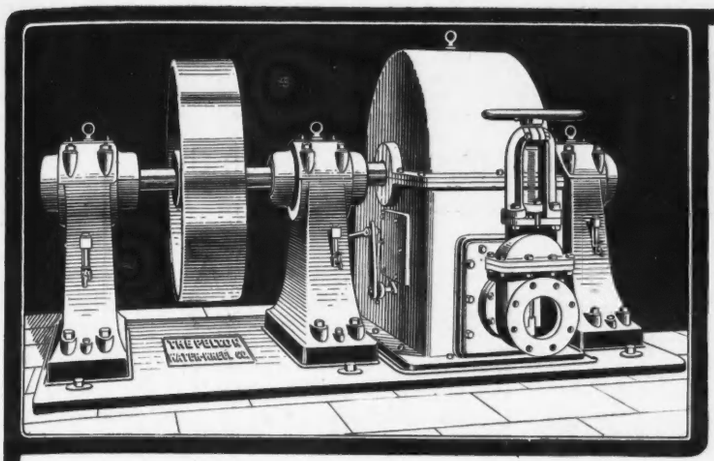

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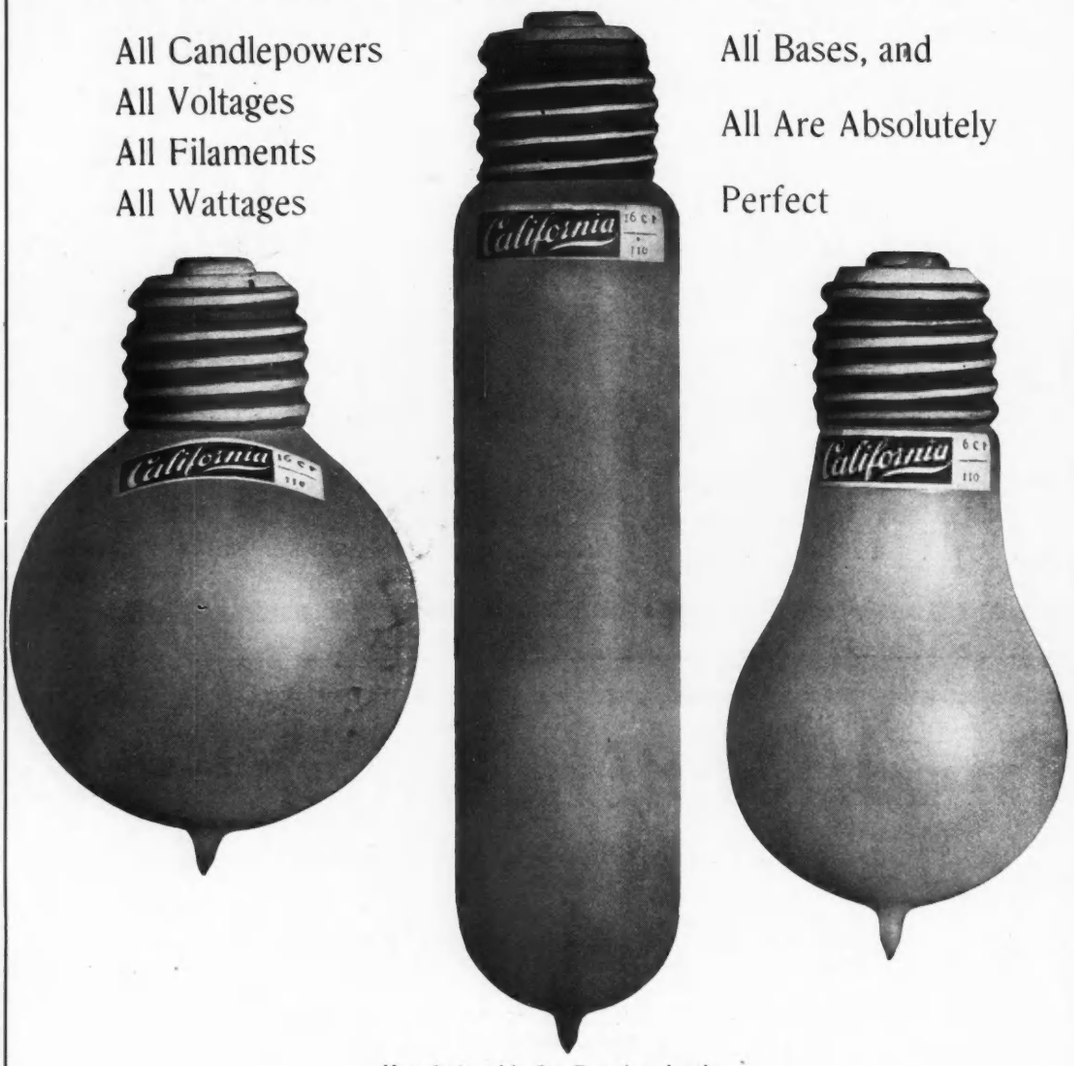

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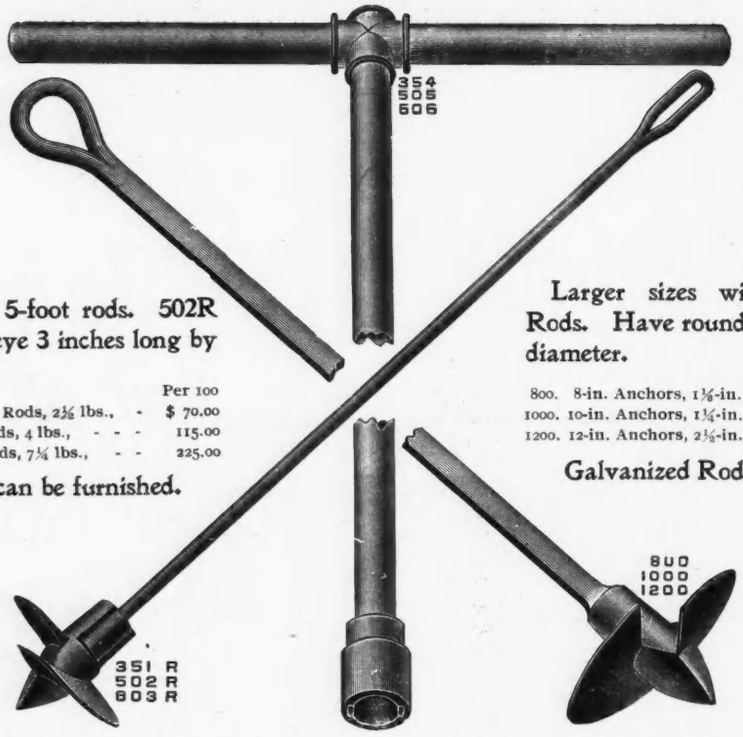

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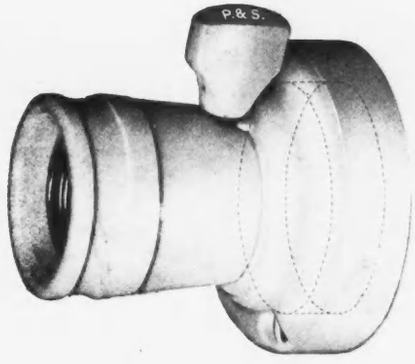

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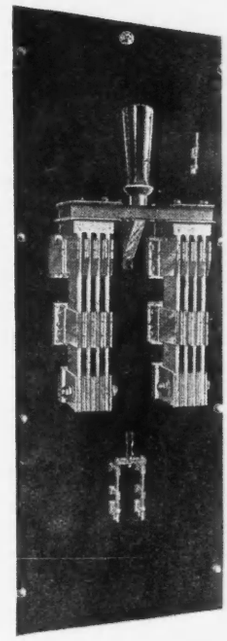

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